INTERNATIONAL MONETARY FUND

2012 SPILLOVER REPORT—BACKGROUND PAPERS

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Approved By
Ranjit Teja

Inputs were coordinated by Rishi Goyal and David Robinson (SPR) from an interdepartmental working group comprising: Ashvin Ahuja, Stephan Danninger, Raphael Lam, Alla Myrvoda, and Malhar Nabar (APD); Bas Bakker, Ferdinand Heinz, Gregorio Impavido, Christoph Klingen, Marta Ruiz-Arranz, Yan Sun, Thiery Tressel, Jérôme Vandenbussche, and Jessie Yang (EUR); Anna Ilyina and Srobona Mitra (MCM); Eugenio Cerutti, Ben Hunt, Keiko Honjo, Jean-Marc Natal. Mousa Shamouilian, and Stephan Snudden (RES), Irena Asmundson, Tam Bayoumi, Trung Bui, Sally Chen, Andrea Maechler, Mehdi Raissi, Nagwa Riad, Mika Saito, Silvia Sgherri, Francis Vitek, and Karim Youssef (SPR); and Geoffrey Keim, Paulo Medas and Martin Sommer (WHD).

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I. OVERVIEW

1. Correlation of Financial Market Asset Prices[1]

Both volatility of financial asset prices and correlations among them have risen since the start of the crisis. They remain high, suggesting that underlying financial market sentiment is dominated by global events, and international asset prices remain a potent source of global spillovers.

1. **Financial markets and asset prices are key conduits of spillovers from one part of the world to another**. Thus, it is useful to examine recent behavior of financial asset prices—in particular their volatility and the correlations across assets—to ascertain whether conditions have started to normalize.

2. **US asset prices are taken to be the canonical prices and are compared with price changes in about 30 other advanced and emerging markets**, given the size of the domestic markets. Replacing US with German asset prices, which could be considered as more appropriate for periods of Euro area problems, produced similar results. Accordingly, the assets considered are: the yield on the US 10 year Treasury bond; the US VIX; the US equity market prices; domestic equity market prices; the oil price in dollars; the non-oil commodity price in dollars; and sovereign CDS spreads for three different types of countries, advanced markets except peripheral Europe, peripheral Europe (Greece, Ireland, Italy, Portugal, and Spain), and emerging markets.

Relative Volatility of Asset Prices
(Standard Errors compared with 2003–07)

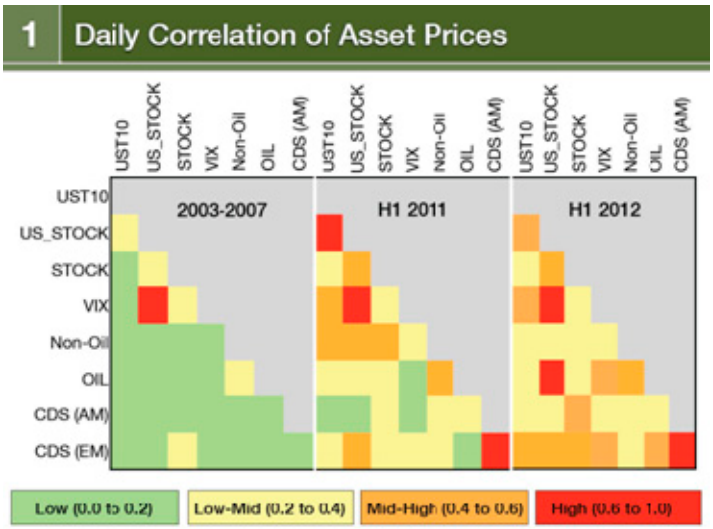
	H1 2011	H1 2012
UST10	1.15	0.90
US Stock	1.25	0.99
Stock	1.09	1.08
VIX	1.74	1.19
Non-Oil	1.38	1.11
Oil	0.91	0.66
CDS (AM)	5.26	5.83
CDS (EM)	2.03	2.06

Fund staff calculations.

3. **There has been a striking increase in financial market volatility since the onset of the crisis, though some differentiation among assets**. Comparing standard deviations of daily prices since the start of 2010 to mid 2011 and the first half of 2012 relative to the pre-crisis period (start 2003 to end 2006) most assets have seen a large increase in volatility. More recently, US assets appear to have benefitted from safe haven flows with volatility declining in some cases below pre-crisis levels.

[1] Prepared by Tam Bayoumi and Trung Bui (SPR).

4. **Asset price correlations suggest that there has been a large change in behavior of financial markets since the onset of the crisis**, and that abnormally high correlations have continued to the present day. Before the crisis the matrix is almost entirely green, with exceptions being correlations within countries (e.g., US bond yields and equity markets) or asset classes (across equity market prices or commodity prices. Once the crisis started, however, the correlation between financial market asset prices jumped and became much more generalized. While there has been some variation in the sources of correlations—for example, advanced economy CDS remained relatively uncorrelated with other asset prices through the end of 2009—the overall pattern remains relatively similar over time. In particular, the period since the start of 2012 continues to see high correlations of daily asset price movements in spite of a series of important policy measures in the Euro area, such as the LTROs, Greek PSI, and the strengthening of the firewall.



5. **Increased asset price correlations together with heightened volatility point to elevated global risk**. Asset prices are now less driven by multiple factors that depend on the type of asset and on the particular risk being contemplated to being driven by a single factor reflecting overall risks.

2. Business Cycle Accounting for the Systemic Five[1]

A business cycle accounting analysis is conducted for systemic economies using the G35 Model. Estimated historical decompositions of output growth indicate that business cycle fluctuations in the United States have been primarily driven by domestic macroeconomic and financial shocks, whereas those in other systemic economies have been primarily driven by foreign macroeconomic and financial shocks, together with world terms of trade shocks. Business cycle comovement across systemic economies has been largely driven by financial shocks in the United States, reflecting the depth of its money, bond, and stock markets.

Introduction

1. **This note conducts a business cycle accounting analysis for systemic economies, with an emphasis on spillover effects from macroeconomic versus financial shocks**. The systemic economies under consideration are China, the Euro Area, Japan, the United Kingdom, and the United States. This analysis is based on historical decompositions of output growth derived from the estimated structural macroeconometric model of the world economy, disaggregated into thirty five national economies, documented in Vitek (2012). Within this framework, each economy is represented by interconnected real, external, monetary, fiscal, and financial sectors. Spillovers are transmitted across economies via trade, financial, and commodity price linkages.

Historical Decompositions of Output Growth

2. **Historical decompositions measure the time varying contributions of mutually exclusive sets of structural shocks to the realizations of endogenous variables**. We distinguish between macroeconomic and financial shocks, originating domestically and abroad, as well as world terms of trade shocks. The macroeconomic shocks under consideration are supply shocks, private demand shocks, monetary policy shocks, fiscal expenditure shocks, and fiscal revenue shocks. The financial shocks under consideration are credit risk premium shocks, duration risk premium shocks, and equity risk premium shocks. These risk premium shocks are identified from observed deviations from the predictions of standard forward looking fundamentals based asset pricing relationships, and accordingly reflect shifts in the price or volume of risk or uncertainty. The terms of trade shocks under consideration are exchange rate risk premium shocks, terms of trade shocks, and world commodity price shocks.

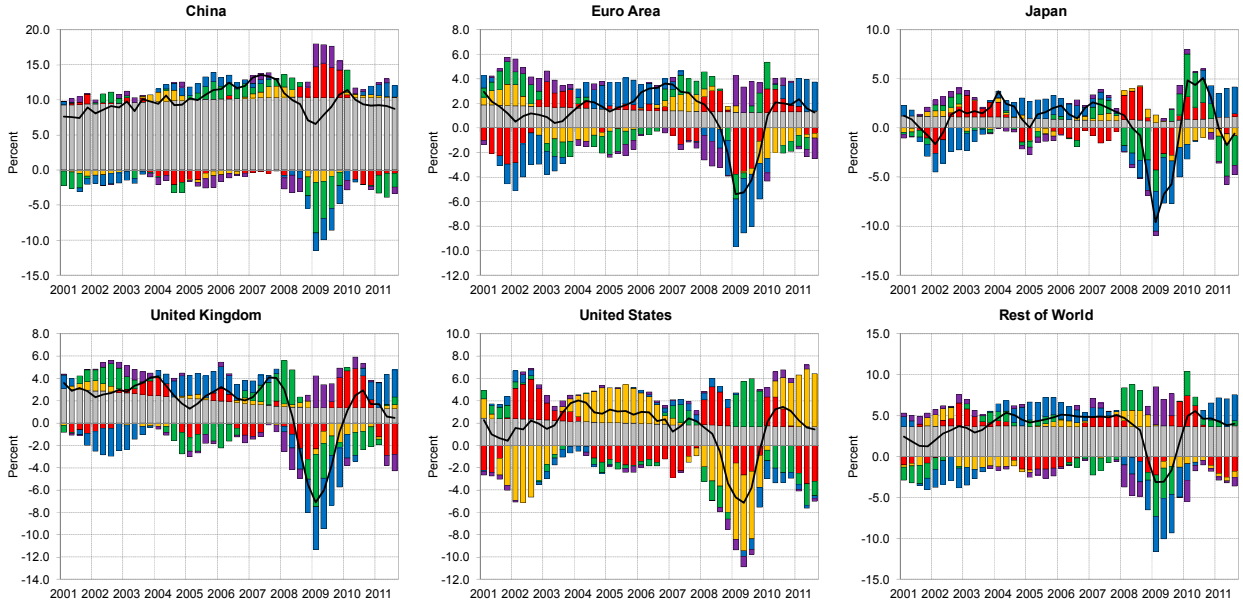
3. **Estimated historical decompositions of output growth in systemic economies attribute business cycle dynamics** around relatively stable potential output growth rates to economy specific combinations of domestic and foreign macroeconomic and financial shocks, together with world terms of trade shocks. Business cycle fluctuations in the United States have been primarily driven by domestic macroeconomic and financial shocks, whereas those in other systemic economies have been primarily driven by foreign macroeconomic and financial shocks, together with world terms of

[1] Prepared by Francis Vitek (SPR).

trade shocks. Business cycle comovement across systemic economies has been largely driven by financial shocks in the United States, reflecting the depth of its money, bond, and stock markets.

4. **Prior to the global financial crisis, cyclical output growth volatility in systemic economies was moderate**, characterized by unsynchronized episodes of offsetting domestic macroeconomic and financial shocks in the Euro Area and the United States. During the global financial crisis, a series of large negative contributions from financial shocks in the United States throughout 2008 and 2009, augmented by a series of moderate negative contributions from macroeconomic shocks there during 2009 after conventional monetary policy space was exhausted, generated a precipitous synchronized global recession. Since the global financial crisis, a sequence of moderate negative contributions from financial shocks in the Euro Area has partially offset a sequence of moderate positive contributions from financial shocks in the United States, decelerating the synchronized global recovery.

Figure 1. Historical Decompositions of Output Growth



Note: Decomposes observed output growth ■ as measured by the seasonal logarithmic difference of the level of output into the sum of a trend component ■ and contributions from domestic macroeconomic ■, domestic financial ■, foreign macroeconomic ■, foreign financial ■, and world terms of trade ■ shocks.

Volatility Regimes

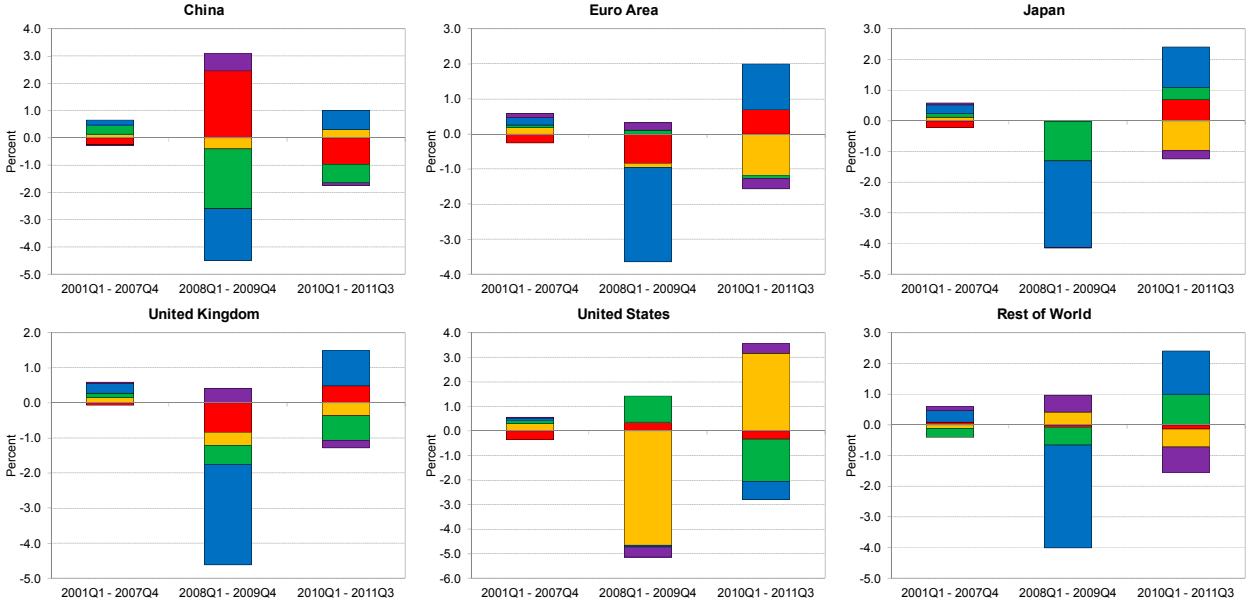
5. **This narrative on the sources of recent business cycle fluctuations in systemic economies suggests the existence of three distinct regimes**, characterized by driving factor volatility differences. Averaging the absolute contributions from different types of structural shocks to cyclical output growth dynamics across the relevant estimation sample subperiods confirms that their dispersion increased substantially during the global financial crisis, and remains elevated relative to the extended period of moderation that preceded it. Underlying these volatility regime shifts are large swings in the contributions from financial shocks in the Euro Area and the United

States. During the global financial crisis, a large negative contribution from domestic financial shocks in the United States generated an abrupt tightening of financial conditions worldwide, causing a precipitous global recession. Since the global financial crisis, a moderate negative contribution from domestic financial shocks in the Euro Area associated with recurring bouts of severe financial stress in the Periphery has decelerated the global recovery.

References

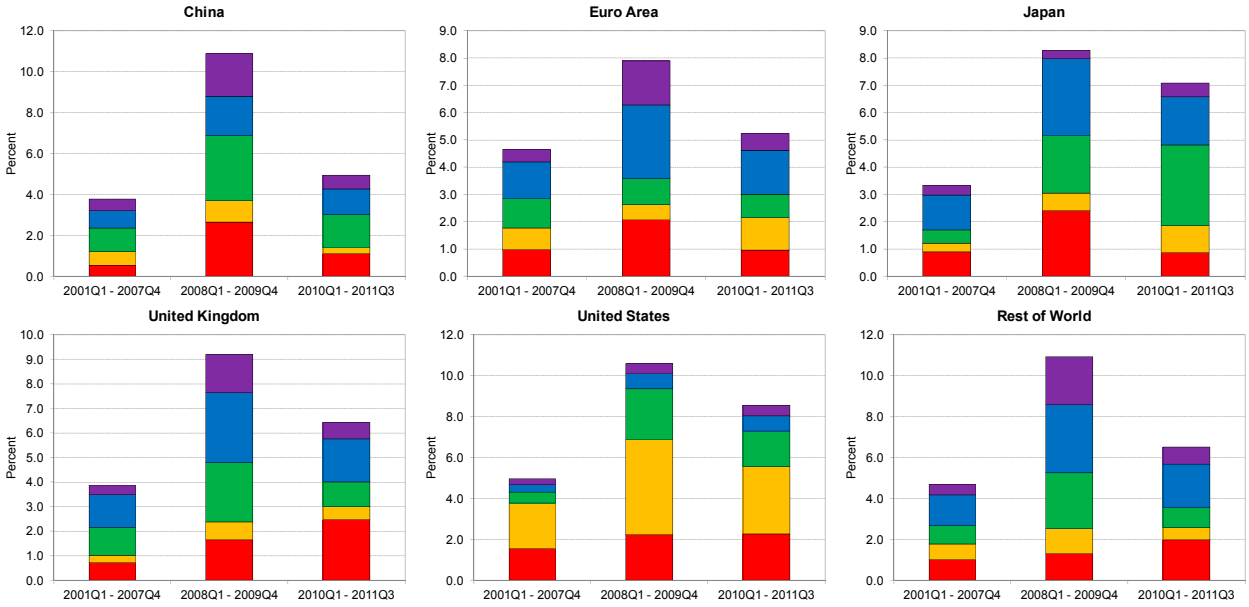
Vitek, F., 2012, "Policy Analysis and Forecasting in the World Economy: A Panel Unobserved Components Approach," IMF Working Paper 12/149, (Washington: International Monetary Fund).

Figure 2. Mean Contributions to Cyclical Output Growth



Note: Depicts the mean contributions to the cyclical component of output growth from domestic macroeconomic ■, domestic financial ■, foreign macroeconomic ■, foreign financial ■, and world terms of trade ■ shocks.

Figure 3. Mean Absolute Contributions to Cyclical Output Growth



Note: Depicts the mean absolute contributions to the cyclical component of output growth from domestic macroeconomic ■, domestic financial ■, foreign macroeconomic ■, foreign financial ■, and world terms of trade ■ shocks.

3. Spillovers from Macroeconomic versus Financial Shocks in the Systemic Five[1]

The impact of spillovers arising from macroeconomic versus financial shocks in systemic economies to the rest of the world is analyzed using the G35 Model. Spillovers from macroeconomic shocks in systemic economies are generally small but concentrated, while those from financial shocks tend to be large and diffuse. Spillovers from financial shocks in the United States are uniquely strong, particularly to geographically close trading partners and emerging economies with open capital accounts.

Introduction

1. **This note analyzes spillovers from macroeconomic versus financial shocks in systemic economies to the rest of the world**. The systemic economies under consideration are China, the Euro Area, Japan, the United Kingdom, and the United States. This analysis is based on the estimated structural macroeconometric model of the world economy, disaggregated into thirty five national economies, documented in Vitek (2012). Within this framework, each economy is represented by interconnected real, external, monetary, fiscal, and financial sectors. Spillovers are transmitted across economies via trade, financial, and commodity price linkages.

Simulation Methodology

2. **Within the framework of our estimated structural macroeconometric model**, the dynamic effects of macroeconomic and financial shocks are transmitted throughout the world economy via trade, financial and commodity price linkages, necessitating monetary and fiscal policy responses to spillovers. Macroeconomic shocks are transmitted via direct financial linkages, while financial shocks are also transmitted via indirect financial linkages representing contagion effects.

3. **We analyze spillovers from macroeconomic and financial shocks in systemic economies to the rest of the world with simulated conditional betas of the output gap**. The macroeconomic shocks under consideration are supply shocks, private demand shocks, monetary policy shocks, fiscal expenditure shocks, and fiscal revenue shocks. The financial shocks under consideration are credit risk premium shocks, duration risk premium shocks, and equity risk premium shocks. These risk premium shocks are identified from observed deviations from the predictions of standard forward looking fundamentals based asset pricing relationships, and accordingly reflect shifts in the price or volume of risk or uncertainty. The simulated conditional betas under consideration measure international business cycle comovement driven by macroeconomic or financial shocks in each systemic economy. In particular, they measure the percent increase in the output gap in the recipient economy which occurs in response to macroeconomic or financial shocks in the source economy which raise its output gap by one

[1] Prepared by Francis Vitek (SPR).

percent, on average over the business cycle. They reflect causality as opposed to correlation, because they abstract from structural shocks associated with other economies.

Simulation Results

4. **On average over the business cycle, output spillovers from systemic economies to the rest of the world** in our estimated structural macroeconometric model are primarily generated by macroeconomic shocks, which contribute more to business cycle fluctuations than financial shocks. This implies weak international business cycle comovement beyond close trading partners. However, during episodes of financial stress in systemic economies, such as during the global financial crisis, international business cycle comovement is more uniformly strong due to the prevalence of financial shocks, which propagate via elevated contagion effects.

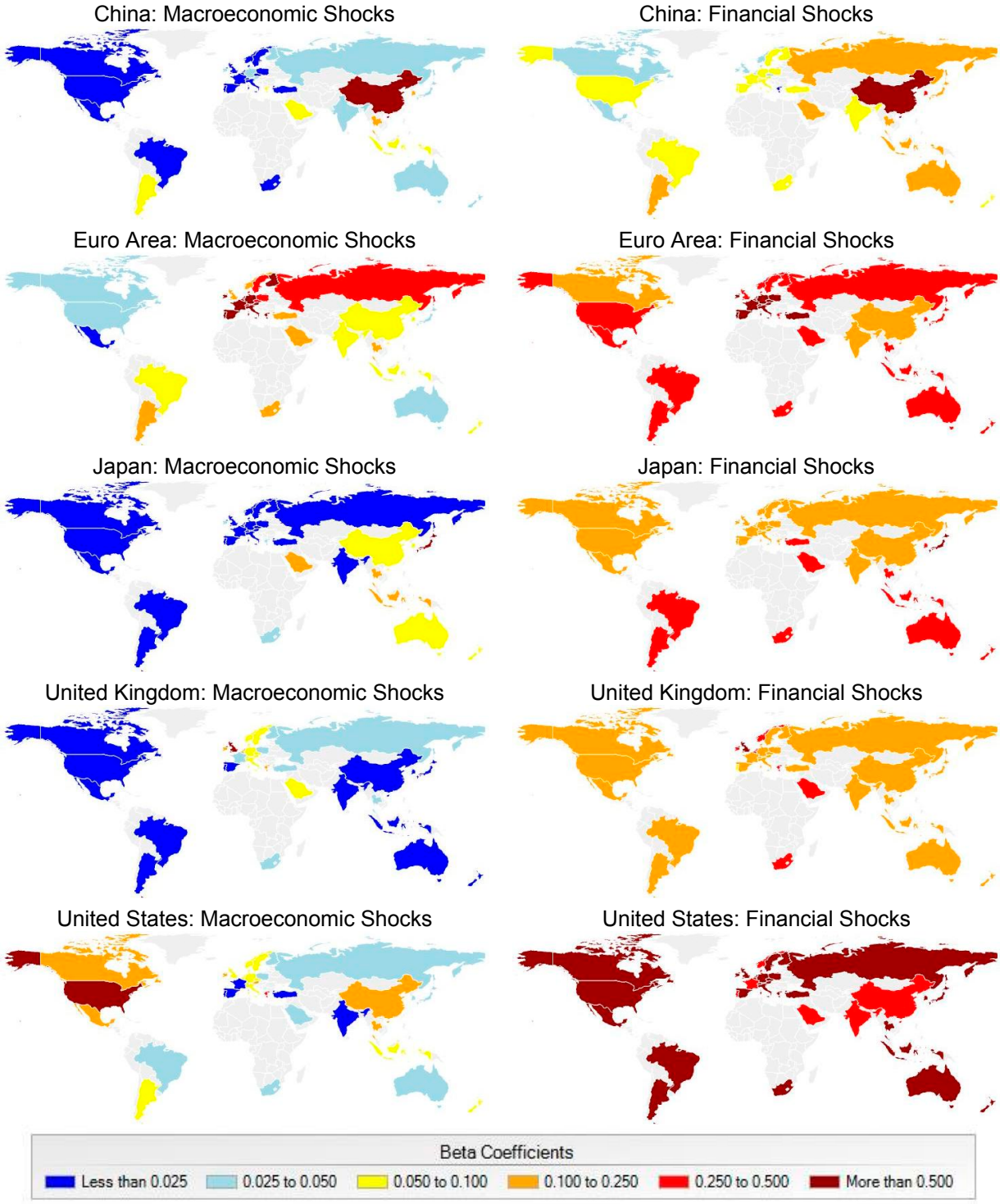
5. **Output spillovers generated by macroeconomic shocks are generally small but concentrated in our structural macroeconometric model**. The pattern of international business cycle comovement driven by macroeconomic shocks primarily reflects bilateral trade relationships, and therefore exhibits gravity. That is, output spillovers generated by macroeconomic shocks tend to be concentrated among geographically close trading partners, which generally have strong bilateral trade relationships due in part to transportation costs. However, this pattern is diluted by supply shocks, which are primarily transmitted internationally via terms of trade shifts, unlike other macroeconomic shocks which are primarily transmitted internationally via domestic demand shifts.

6. **Output spillovers generated by financial shocks are generally large and diffuse in our structural macroeconometric model**. The pattern of international business cycle comovement driven by financial shocks transcends bilateral portfolio investment relationships, which tend to be weak reflecting home bias. Output spillovers generated by financial shocks are primarily transmitted via international comovement in financial asset prices. Given that bilateral trade relationships are generally weak beyond close trading partners, accounting for strong international comovement in financial asset prices requires strong international comovement in risk premia. The intensity of these contagion effects varies across source and recipient economies. They are uniquely strong from the United States, reflecting the depth of its money, bond, and stock markets. They are strong to emerging economies with open capital accounts, moderate to advanced economies, and weak to emerging economies with closed capital accounts.

References

Vitek, F., 2012, "Policy Analysis and Forecasting in the World Economy: A Panel Unobserved Components Approach," IMF Working Paper 12/149, (Washington: International Monetary Fund).

Figure 1. Betas of the Output Gap Conditional on Macroeconomic and Financial Shocks



Note: Depicts the simulated betas of the output gap with respect to the contemporaneous output gap in systemic economies conditional on macroeconomic or financial shocks in each of these systemic economies. These betas are calculated with a Monte Carlo simulation with 999 replications for $2T$ periods, discarding the first T simulated observations to eliminate dependence on initial conditions, where T denotes the observed sample size.

II. EURO AREA

4. Commonalities, Mispricing, and Spillovers: Another Look at Euro Area Sovereign Risk[1]

EA sovereign risk premiums reached an all time high in November 2011. LTROs eased funding pressures in early 2012 but do not address underlying solvency issues and funding stresses have returned. Unsurprisingly, recent movements in sovereign risk premiums reflect predominantly EA risk commonalities. The key policy implication is that market concerns may not fully dissipate until the European policy framework as a whole (banking supervisory framework, fiscal liability sharing scheme, role of ECB as lender-of-last resort, etc.) is strengthened, thereby reducing the market perception of EA-wide risks. In terms of spillover risks to the rest of the world, increased EA sovereign risk is likely to worsen significantly the perceived credit riskiness of EA financial corporate bonds—given feedback loops between sovereign and financial balance sheets. In turn, if (and only if) global risk repricing is factored in, volatility spillovers from the EA financial sector have the potential to raise significantly not only the perceived riskiness of EA nonfinancial corporate bonds, but also that of EM sovereigns and US financial and nonfinancial corporate.

To what extent do movements in euro area sovereign spreads reflect country-specific risk factors rather than a repricing of euro area wide risk?

1. **Commonalities**. As the EA sovereign bond market is highly integrated, spreads tend to move together—especially in times of crisis—with the yield spread of 10-year EA bonds over Bunds influenced not only by country-specific risks, but also by investors' repricing of "common EA risk".

2. **Model**. The risk factors driving the dynamics of EA spreads during the crisis is assessed via a panel of the spread between the yield on 10-year sovereign bonds between 10 EA countries and Germany estimated over January 2001 to May 2012 using monthly data. Variables used to proxy for investors' assessments of country-specific credit risk include: expected changes in debt stock and future fiscal balances (fiscal risk); projected shifts in current account balances, growth, and inflation rates (macro risks) obtained from the Economist Intelligence Unit forecasts (note that—unlike actual macroeconomic variables—professional forecasts are genuinely exogenous factors to spread dynamics); possible effects on default risk premiums arising from vulnerabilities in national financial systems are captured by the Expected Default Frequency of the median financial institution of each country, obtained from the Moody's Creditedge dataset; and, the relative volume of a country's traded euro denominated long-term government bonds is included among the regressors to proxy for the liquidity of its domestic bond market. The principal component of the yield spreads is used to capture investors' repricing of common area-wide risk factors, while controlling for recent ECB

[1] Prepared by Silvia Sgherri (SPR).

interventions (such as the introduction of the SMP in May 2010 and the three-year Long-term Refinancing Operation (LTRO) loans in December 2011 and February 2012.

3. **Key findings**

- Risk commonalities continue to dominate market pricing dynamics. After reaching its all-time high in November 2011 (at 280bps), the EA risk premium (as estimated by the principal component analysis) is found to have crawled down until end-March 2012 (to 180bps), before increasing again over recent months (to 225bps). By easing funding pressures, the ECB intervention was initially able to stem the downward spiral that EA sovereign bond markets had taken in 2011. However, LTROs do not address the underlying solvency issues and ultimately banks' funding stresses can quickly return—as has indeed happened.

- Country-specific risk factors are also important but their contribution is modest, on the order of 10 percent for most countries. Country specific factors—such as market perception about their growth outlook, their fiscal stance, the relative liquidity of their bond markets and, more importantly, the relative strength and solvency of their banking sector—have started playing a significant role in determining sovereign spread dynamics since the beginning of the financial crisis, meaning that markets do now discriminate across bond issuers on the basis of all these factors.

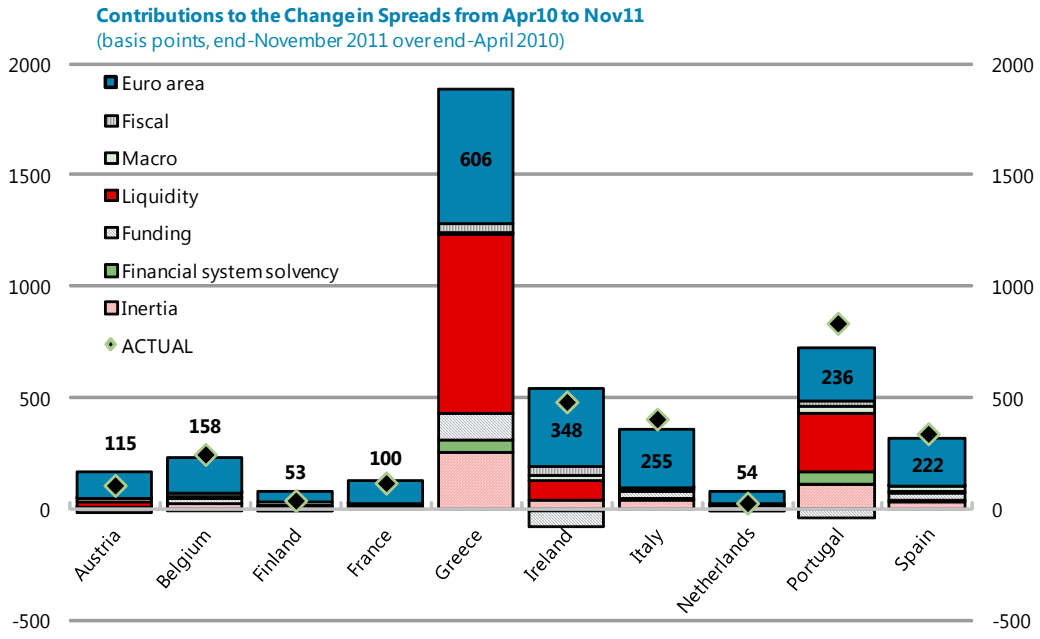
Is there any Evidence of Mispricing of the EA Risk Premium?

4. **Mispricing**. The common risk component can also be used to analyze the extent to which markets misprice the riskiness of a "theoretical" EMU bond. In theory, the yield of a (non-German) EA bond would be the sum of the underlying Bund yield and the euro-area risk premium. The latter can be proxied by the estimated principal component of the country-specific yield spreads.

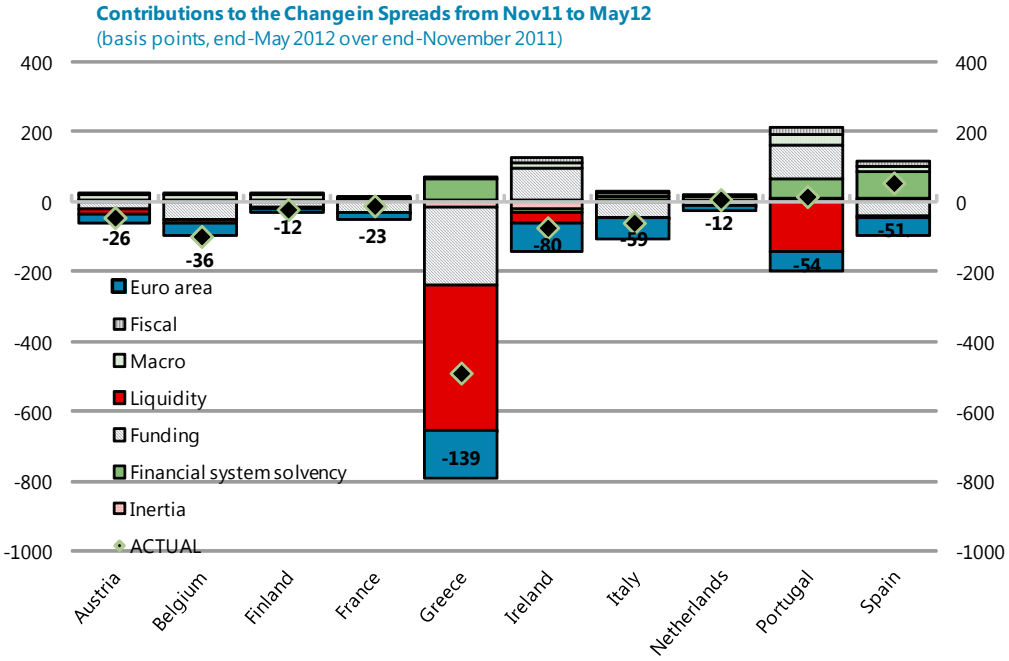
5. **Results**:

- From the second half of 2009 until the second half of 2011—the yield of a market-priced EMU bond index tracks almost perfectly the "theoretical" yield. On the other hand, during 2008–2009, markets seem to have *under*priced EA risk by some 20-60 bps, while there is some evidence of a slight *over*pricing of EA risk starting from July 2011 onwards which is—however—lately fading away.

Figure 1. What's Driving Euro Area Sovereign Spreads?

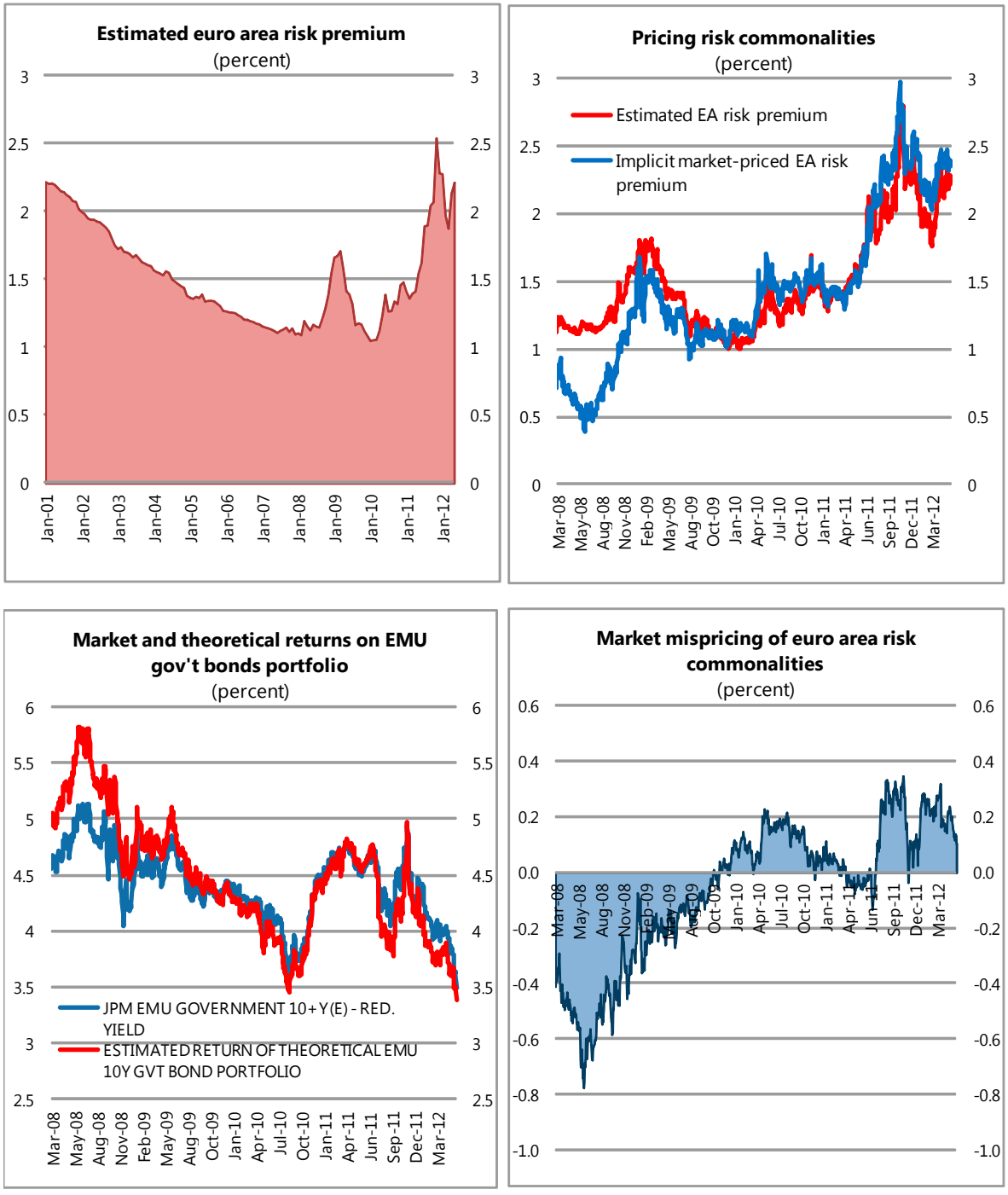


Sources: Bloomberg, Datastream, Economist Intellingence Unit, staff calculations.



Sources: Bloomberg, Datastream, Economist Intellingence Unit, staff calculations.

Figure 2. (Mis)Pricing the Euro Area Risk Premium



Sources: Bloomberg, Datastream, and Fund staff calculation.

Volatility Spillovers Across Assets and Across Borders

6. **Model**. Dynamic Conditional Correlation (DCC) estimators are used to unveil time-varying cross-correlations in a portfolio of global assets, including our estimates for EA-wide sovereign risk.[2] DCC models have the flexibility of univariate GARCH models coupled with a parsimonious parametric model for time-varying cross-correlations. They are not linear, but can be estimated very simply with two-step methods based on their likelihood function.[3]

7. **Interpretation.** The principal component of the risk premiums embedded in the examined asset portfolio is used to capture investors' *global* risk repricing. In this way, volatility cross-correlations vis-à-vis the EA sovereign bond market and the EA financial corporate bond market are estimated using either *observed* risk premiums (so that shifts in global risk repricing are factored in), or (unobserved) risk premiums which have been stripped out of any change in global risk repricing (so that only structural interdependences are captured by the correlation matrix).

8. **Key findings**

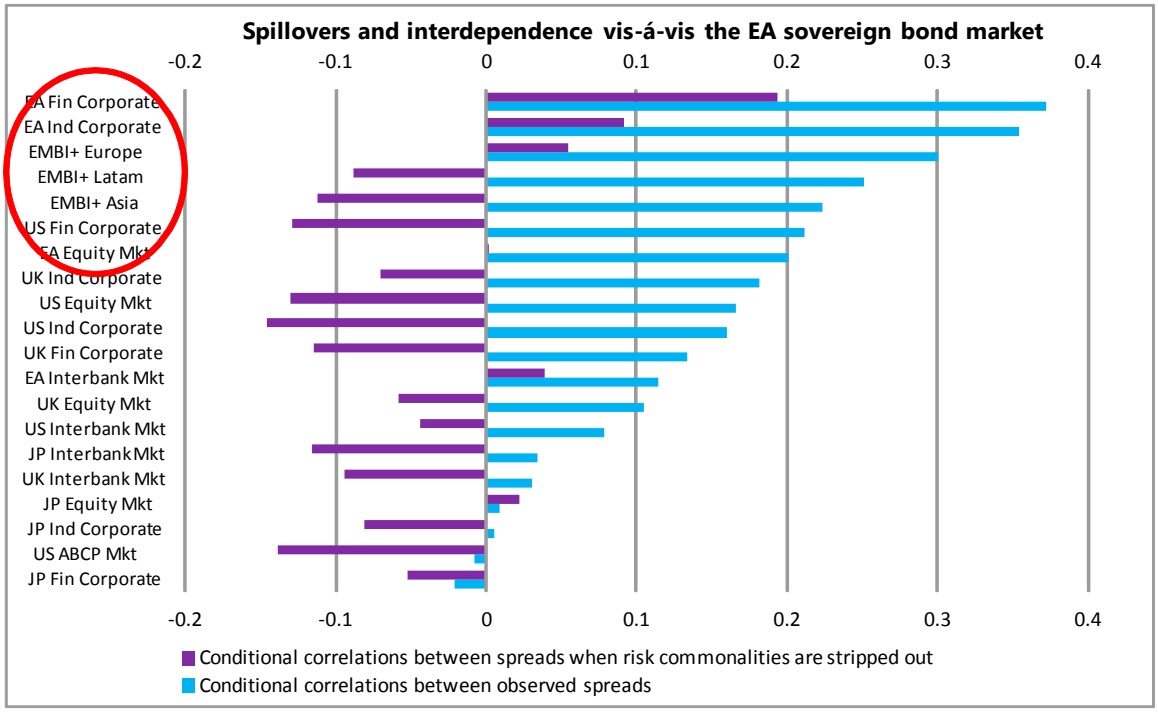
- If shifts in global risk commonalities are factored out, volatility in EA sovereign bond markets is likely to worsen significantly the perceived riskiness of EA financial corporate bonds—given feedback loops between sovereign and financial balance sheets. In turn, volatility in the EA financial corporate bond market is likely to spill over to the EA nonfinancial corporate bond market, but not beyond it. In other words, if global risk repricing is not accounted for, no significant spillover effect is found beyond EA borders for any asset class included in the portfolio.

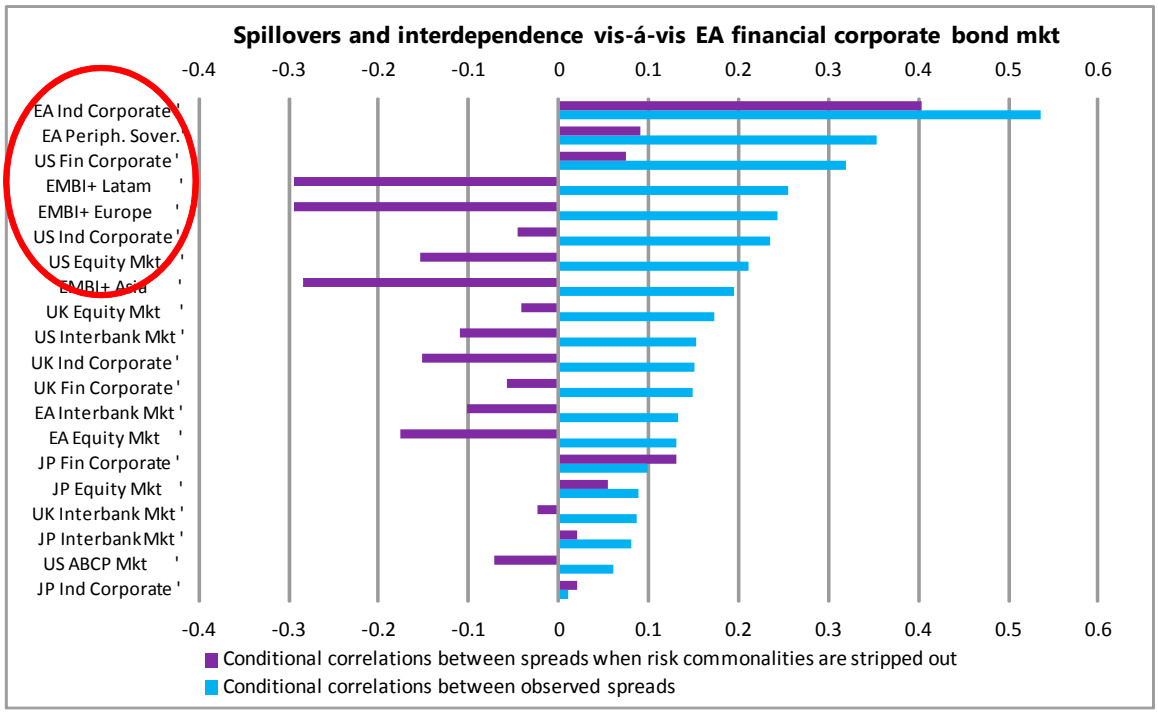
- On the other hand, if global risk repricing is allowed to play out, volatility spillovers are likely to be sizable across assets and across borders. Specifically, significant volatility spillovers from the EA sovereign bond market are likely to be felt also in all EM bond markets around the globe, as well as in the US financial corporate bond market (and, marginally, in the US equity market).

[2] The analysis relies on the set of risk premiums embedded in the following yield differentials: US asset-backed commercial paper (versus the 3-month US Treasury bond yield); 3-month US dollar, euro, sterling, and yen London interbank offered rates (versus their corresponding overnight index swap rates); US, euro-area, UK, and Japanese high-yield financial and industrial corporate bonds (versus their respective benchmark 10-year government bond yields); US, euro-area, UK, and Japanese equities (whose implied risk is computed as the earning price ratio versus their respective benchmark 10-year government bond yields); the estimated EA risk premium previously extracted from the 10-year sovereign bonds (over Bunds) for 10 euro-area countries; and the implied spreads of Asia, Europe, and Latam Emerging Markets Bond Index Plus (EMBI+).

[3] DCC models were first introduced by Engle R. (2002) "Dynamic conditional correlation: A new simple class of multivariate GARCH models", *Journal of Business and Economic Statistics*, Vol. 17, 425–446.

Figure 3: Cross-borders and cross-assets spillovers vis-a-vis EA Markets





Source: Blooomberg, Datastream, Fund staff calculations.

5. Effects of an Intensification of the Euro Area Sovereign Debt Crisis[1]

The global macroeconomic costs of a potential future intensification of the Euro Area Sovereign Debt Crisis are analyzed using the G35 Model. The simulation results indicate that the intensification of financial stress in high yield Euro Area countries would generate severe output losses in the Euro Area, concentrated in the high yield countries and to a lesser extent the mid-yield countries, together with mild to moderate output losses in the rest of the world, concentrated in the European Union. The scope for monetary and fiscal policy responses in the rest of the world to mitigate spillovers varies considerably across economies, primarily reflecting differences in their policy space.

Introduction

1. **This note analyzes the global macroeconomic costs of the potential future intensification of the Euro Area Sovereign Debt Crisis**, with and without accounting for feasible monetary and fiscal policy responses in the rest of world. This analysis is based on a scenario simulated with the structural macroeconometric model of the world economy, disaggregated into thirty five national economies, documented in Vitek (2012). Within this framework, each economy is represented by interconnected real, external, monetary, fiscal, and financial sectors. Spillovers are transmitted across economies via trade, financial, and commodity price linkages.

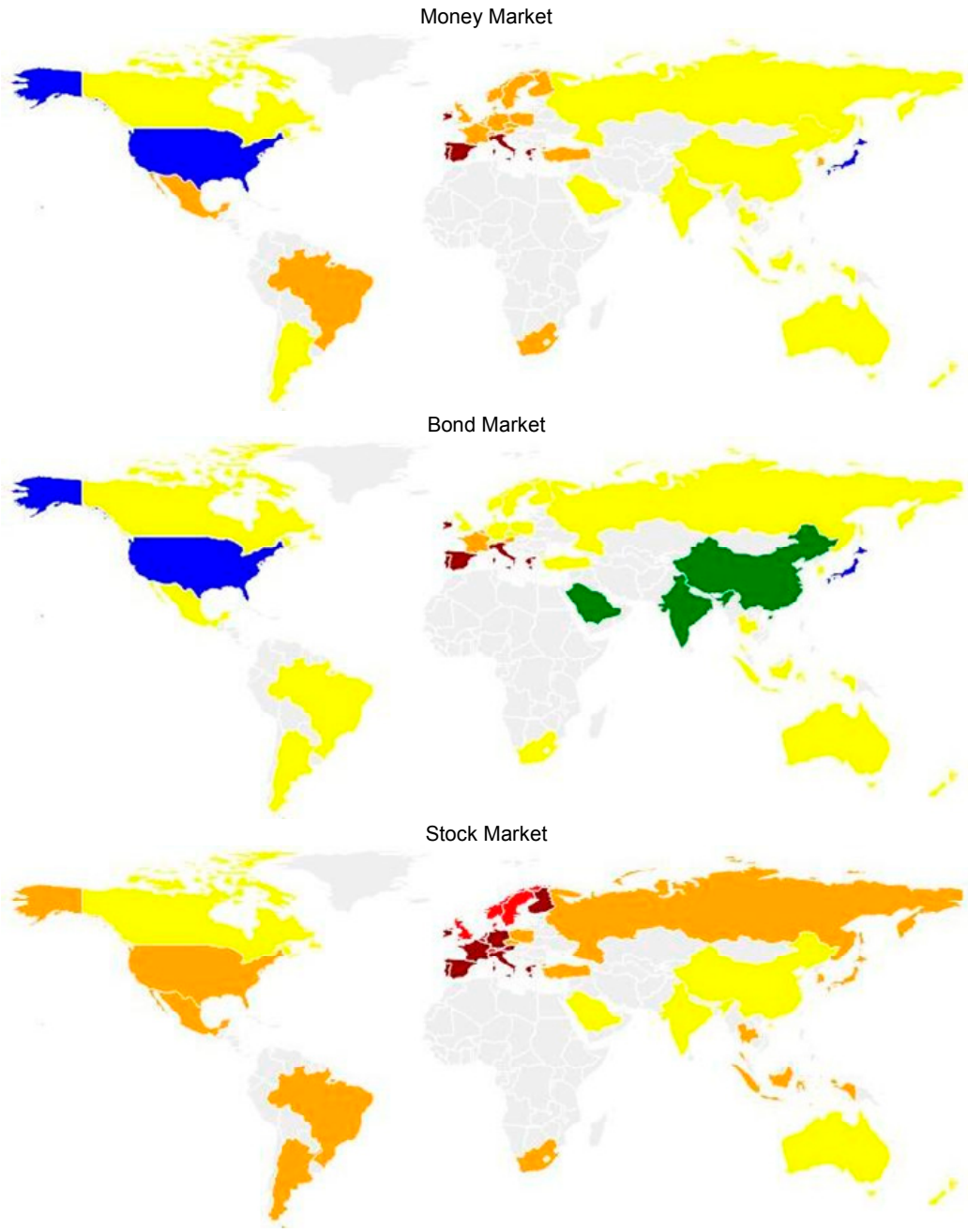
2. **Our simulation results indicate that the intensification of financial stress in the high yield Euro Area countries would generate severe output losses in the Euro Area**, concentrated in the high yield countries and to a lesser extent the mid-yield countries, together with mild to moderate output losses in the rest of the world, concentrated in the European Union. The scope for monetary and fiscal policy responses in the rest of the world to mitigate spillovers varies considerably across economies, primarily reflecting differences in their policy space.

Financial Market Spillovers

3. **The intensification of the Euro Area Sovereign Debt Crisis has been largely driven by contagion in the money, bond and stock markets**. Accordingly, we enrich our scenarios with an event study analysis of financial market spillovers generated by developments in the Euro Area during the Fall of 2011. This event study analysis indicates that money and bond market contagion from the Euro Area—as measured by impacts on one and ten year government bond yields during this period—was benign to moderate. In contrast, they indicate that stock market contagion—as measured by impacts on equity price indexes—was moderate to severe.

[1] Prepared by Tam Bayoumi and Francis Vitek (SPR).

Figure 1. Estimated Financial Market Spillovers



Note: Depicts estimated financial market spillover coefficients less than 0.00 ■, between 0.00 and 0.05 ■, between 0.05 and 0.25 ■, between 0.25 and 0.50 ■, between 0.50 and 0.75 ■, and greater than 0.75 ■.

Scenario Simulations

4. **We simulate a scenario representing the intensification of the Euro Area Sovereign Debt Crisis**. We also simulate subscenarios to assess the scope for feasible monetary and fiscal policy responses in the rest of the world to mitigate spillovers. We assume that all of the shocks driving this scenario are temporary but persistent, following first order autoregressive processes having coefficients of 0.975. We also assume that monetary policy responses are constrained by the zero lower bound on the nominal policy interest rate in the Euro Area, Japan, the United Kingdom, and the United States.

5. **Our scenario represents the intensification of the Euro Area Sovereign Debt Crisis** with the escalation of financial stress and deterioration of confidence, which triggers procyclical fiscal consolidation reactions. These effects are differentiated across the high yield (Greece, Ireland, Italy, Portugal, and Spain), the mid-yield (Austria, Belgium, and France), and the low yield (Finland, Germany, and Netherlands). We represent the intensification of stress in the money, bond, and stock markets of the high yield with positive credit risk premium shocks which raise short-term nominal market interest rates by 200 basis points, positive duration risk premium shocks which raise long-term nominal market interest rates by 300 basis points, and positive equity risk premium shocks which reduce equity prices by 40 percent. These risk premium shocks are correlated internationally to account for contagion effects, with beta coefficients calibrated to match our event study results. We account for confidence losses by households and firms with negative private domestic demand shocks which gradually reduce domestic demand by 2.5 percent in the high yield, by 2.0 percent in the mid-yield, and by 1.5 percent in the low yield. We assume fiscal consolidation reactions by governments which gradually raise the ratio of the fiscal balance to nominal output by 3.0 percentage points in the high yield, by 2.0 percentage points in the mid-yield, and by 1.0 percentage points in the low yield. Expenditure measures represented by negative fiscal expenditure shocks account for 75 percent of these fiscal consolidations, while revenue measures represented by positive fiscal revenue shocks account for the remainder. Finally, there is a run on the euro, represented by an exchange rate risk premium shock which depreciates it by 20.0 percent in nominal effective terms.

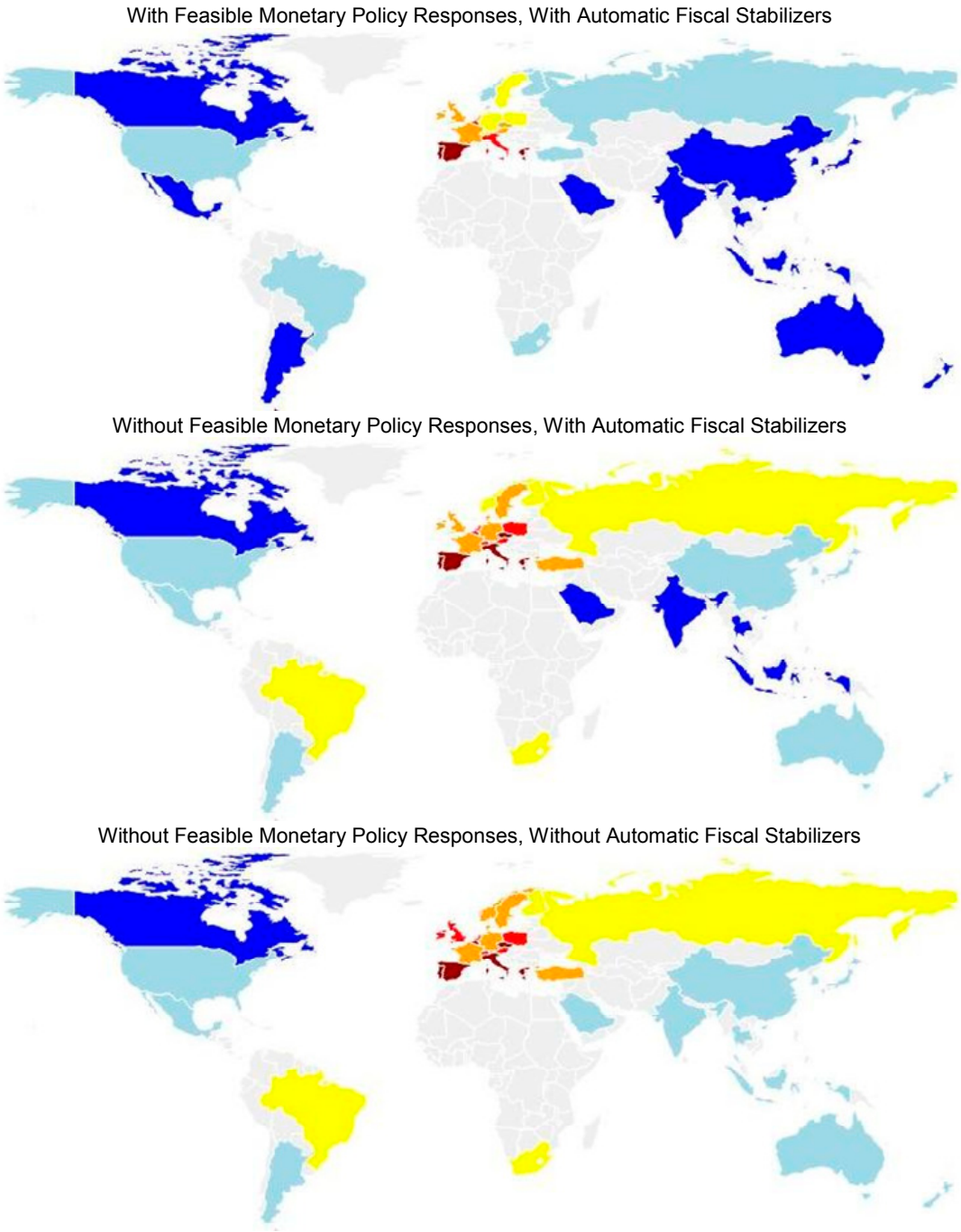
6. **Under this scenario, severe output losses in the Euro Area**, concentrated in the high yield and to a lesser extent the mid-yield, are accompanied by mild to moderate output losses in the rest of the world, concentrated in the European Union. Accounting for feasible monetary policy responses and automatic fiscal stabilizers in the rest of the world, simulated peak output losses within the Euro Area range from 4.5 to 7.7 percent in the high yield, to 4.9 to 6.0 percent in the mid-yield, to 2.0 to 5.3 percent in the low yield. Outside of the Euro Area, simulated peak output losses range from 0.4 to 4.7 percent in other advanced economies, and from 0.2 to 4.5 percent in emerging economies. Abstracting from feasible nominal policy interest rate cuts with offsetting positive monetary policy shocks generally amplifies these spillovers, with simulated peak output losses ranging from 0.7 to 5.7 percent in other advanced economies, and from 0.9 to 7.7 percent in emerging economies. Also abstracting from automatic deteriorations in the ratio of the fiscal balance to nominal output with offsetting negative fiscal expenditure shocks generally further

amplifies these spillovers, with simulated peak output losses ranging from 0.9 to 5.9 percent in other advanced economies, and from 1.0 to 8.0 percent in emerging economies. Aggregating these results implies a simulated peak world output loss of 2.4 to 3.2 percent, depending on the degree to which monetary and fiscal policies respond. The associated peak decline in the price of energy commodities ranges from 7.9 to 16.0 percent, while that for the price of nonenergy commodities ranges from 4.1 to 9.8 percent.

References

Vitek, F., 2012, "Policy Analysis and Forecasting in the World Economy: A Panel Unobserved Components Approach," IMF Working Paper 12/149, (Washington: International Monetary Fund).

Figure 2. Simulated Peak Output Losses



Note: Depicts simulated peak output losses less than 1.0 percent ■, between 1.0 and 2.5 percent ■, between 2.5 and 4.0 percent ■, between 4.0 and 5.5 percent ■, between 5.5 and 7.0 percent ■, and greater than 7.0 percent ■

6. Spillovers between Western Europe and CESEE [1]

Economic and financial linkages between Western Europe and Central, Eastern, and Southeastern Europe (CESEE) have become much tighter in the past two decades. As a result, west-east spillovers are very significant and have begun to also travel from east to west. Financial and trade channels are the main avenues for spillovers and they are mutually reinforcing, with shocks to credit flows in one direction quickly followed by shocks to trade flows in the other direction.

The impact of the euro area crisis on CESEE remained very modest until the summer of 2011, but CESEE started to suffer from contagion through bank funding and exchange rate channels when significant deleveraging by BIS-reporting banks took place in the second half of 2011. The introduction of the ECB's 3 year LTROs has since brought respite. However, downside risks remain significant, and an intensification of the euro area crisis would have significant spillovers to CESEE, especially in countries with elevated vulnerabilities and home-grown challenges.

Introduction

1. **This note discusses linkages and spillovers between Western Europe and Central, Eastern, and Southeastern Europe (CESEE)**. Western Europe and the CESEE regions closely match the regions often referred to as advanced and emerging Europe, with important exceptions—the CESEE includes Estonia, the Czech Republic, the Slovak Republic, which are classified as advanced economies by the WEO.[2] The note is organized as follows: Section II discusses trade, banking and other financial sector linkages between Western Europe and CESEE; Section III analyzes spillovers empirically; Section IV discusses the main spillovers and spillover risks from the euro area crisis; and Section V discusses policy implications of the close linkages.

Linkages between Western Europe and CESEE

2. **Globalization and European integration have lead to increasing tight economic and financial linkages between Western Europe and CESEE**. Linkages are particularly pronounced in the area of trade and banking, with much of CESEE's banking systems owned and financed by the west. Financial-market linkages are also important. More elusive confidence channels and remittances flows tie Europe's economies further together.

[1] Prepared by Bas Bakker, Ferdinand Heinz, Gregorio Impavido, Christoph Klingen, Yan Sun, Jérôme Vandenbussche, and Jessie Yang (EUR).

[2] Western Europe comprises Austria, Belgium, Cyprus, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Malta, the Netherlands, Portugal, and Spain in the euro area; and Denmark, Iceland, Norway, Sweden, Switzerland, and the United Kingdom. CESEE comprises the Czech Republic, Hungary, Poland, the Slovak Republic, and Slovenia in Central Europe; Estonia, Latvia, and Lithuania in the Baltics; and Albania, Bosnia and Herzegovina, Bulgaria, Croatia, FYR Macedonia, Montenegro, Romania, and Serbia in Southeastern Europe; and Belarus, Moldova, Russia, and Ukraine in the European CIS; and Turkey.

Trade linkages

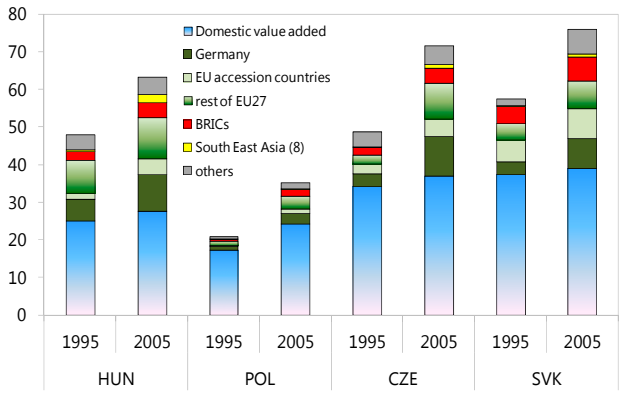
3. **In the past twenty years, trade linkages between CESEE and Western Europe have increased rapidly**. Integration was boosted by the liberalization and westward reorientation of CESEE following the collapse of communism, the eastward expansion of the EU, and globalization generally.

- For Western Europe, CESEE has been the most dynamic export market. Western Europe's exports of goods to CESEE have increased from slightly less than 1 percent of GDP in 1995 to about 3¼ percent of GDP in 2010, and are now higher than those to Asia or Western Hemisphere countries.[3] Germany in particular benefitted from rapidly growing eastward exports. During 2003–08, exports to CESEE helped boost Germany's export growth from 6½ percent to 8¼ percent, equivalent to a ¾ percentage points boost to GDP growth.

- For CESEE, Western Europe is the largest export market—more important than CESEE itself. In 2010, exports of CESEE to Western Europe were about 15 percent of CESEE's GDP.

4. **Trade linkages are further cemented by supply chain integration**. German firms in particular have set up new production facilities in Central Europe, and shifted part of their production to the region. Within these production chains, which are particularly prevalent in sectors like automobiles, Western Europe typically produces the core components; the assembly of the final product is done in CESEE. Other forms of FDI have also been high. The stock of FDI in the region is about 22 percent of GDP on average, and FDI comes almost exclusively from advanced Europe. The rising importance of cross-border supply chains is evident in the sharp increase in the foreign valued added part of gross exports, especially in Central Europe (Figure 1).

Figure 1. Value-added breakdown of Exports
(Percent of GDP)



Sources:

5. **Trade linkages are particularly important for Central Europe and the Baltics.** For Central Europe (Poland, Hungary, the Czech and Slovak Republics, and Slovenia), exports to Western Europe are around 65 percent of its total exports, and close to 32 percent of GDP (Table 1). Southeastern Europe is less integrated. It has fewer cross-border production chains and trades

Table 1. CESEE: Exports to Western Europe, 2011

	(% total exports)	(% of GDP)
Central Europe	63.1	33.7
Baltics	41.0	25.3
Southeastern Europe	51.3	16.2
CIS and Turkey	39.9	8.8

Sources: IMF, Direction of Trade database; and IMF, World Economic Outlook Database.

[3] Data are for exports of goods only, as direction of trade statistics do not exist for exports of services.

less—including with Western Europe. Large commodity exporters such as Russia and Ukraine have considerable trade relations with non-western European countries and thus are less dependent on Western Europe.

Banking Sector Linkages

6. **The financial sector in CESEE has become closely integrated with the banking sector in advanced Europe, both in terms of ownership and financing**.

- Foreign banks, largely from Western Europe control on average 64 percent of domestic banking system assets in the region.[4] Foreign ownership ranges from less than 35 percent in Russia, Turkey, Slovenia, and Belarus, to more than 80 percent in Bosnia, Czech Republic, Croatia, Estonia, Romania, and Slovakia (Figure 2, top left). Foreign control is concentrated in a handful of Western European countries, in particular Austria, France, Greece, Italy, and Sweden (Table 2).[5]

- The integration has been important also in terms of financing (Figure 2, bottom left). Funding by BIS-reporting banks at end-2011 amounted to more than 30 percent of GDP in Croatia, Latvia, Slovenia, Estonia, Hungary, and Bulgaria. It mostly takes the form of parent bank financing to CESEE affiliates and direct lending to corporations. However, in Russia and Turkey, where foreign ownership of banking systems is relatively low, cross-border wholesale funding is more important.

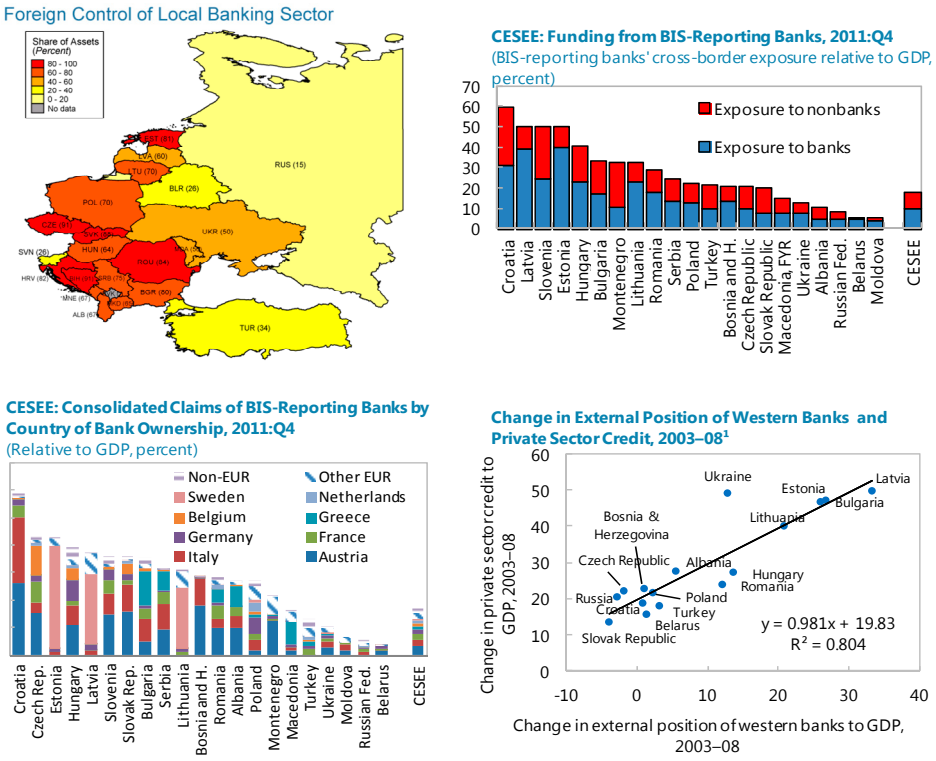
- Consolidated assets of Western European banks, which also take into account assets funded from local deposits represent over 50 percent of GDP in all countries in the region except the CIS, Turkey, Macedonia, and Montenegro (Figure 2, top right).[6] Austrian, Italian, and French banks have the largest presence when measured in terms of total foreign claims.

[4] We consider that a foreign bank has a controlling share when it owns more than 25 percent of a local bank and it is the largest shareholder.

[5] Italian banks have the largest market share in Croatia, Poland, Russia, Serbia, and Slovenia; Austrian banks have the largest market share in Albania, Bosnia, Czech Republic, Hungary, Romania, and Slovakia; Spanish banks have the largest market share in Turkey while Greek banks have the largest market share in Macedonia and Bulgaria. Finally, Swedish banks dominate the Baltic countries.

[6] The foreign (consolidated) claims include all assets of subsidiaries (including assets funded from local deposits and other forms of local funding); the locational statistics only include cross-border claims. In the Czech Republic, foreign claims are high, as the banking system is largely foreign owned, but cross-border claims are not, as domestic credit is mostly funded from domestic deposits.

Figure 2. Banking Sector Linkages



Sources: BIS, Locational Banking Statistics; IMF, *International Financial Statistics*; IMF, World Economic Outlook database; EUREE Banking Sector Structure database; and IMF staff calculations.
[1]As the boom in the Baltic states ended in 2007, data for the Baltics refer to 2002–07.

Table 2. Ranking of Foreign Control of Domestic Banking Sector, Percent of Total Assets

CESEE	1st largest		2nd largest		3rd largest		4th largest		Total
Country	Country	Share	Country	Share	Country	Share	Country	Share	
Czech Republic	Austria	29.3	Belgium	28.4	France	19.3	Italy	6.3	90.8
Bosnia and H.	Austria	38.2	Italy	26.6	Slovenia	9.6	Russian Fed.	6.0	90.6
Slovak Republic	Austria	42.0	Italy	28.2	Belgium	10.2	Russian Fed.	2.5	88.2
Romania	Austria	34.3	Greece	16.6	France	14.3	Italy	7.7	83.5
Croatia	Italy	39.1	Austria	32.1	France	6.1	Hungary	2.9	82.2
Estonia	Sweden	78.4	Latvia	2.2	Cyprus	0.4			80.9
Bulgaria	Greece	25.0	Italy	15.9	Hungary	11.7	Austria	9.0	79.9
Serbia	Italy	22.5	Austria	16.0	Greece	14.2	France	6.7	75.4
Lithuania	Sweden	53.5	Norway	13.9	Italy	1.7	Latvia	1.2	70.3
Poland	Italy	12.8	Germany	11.5	Netherlands	9.7	Spain	7.0	70.0
Montenegro	Hungary	24.1	Austria	23.1	Slovenia	17.5	Serbia	2.7	67.4
Albania	Austria	30.4	Italy	13.2	Greece	9.9	France	8.6	67.2
Macedonia, FYR	Greece	24.6	Slovenia	20.2	France	6.2	Austria	4.8	64.7
Hungary	Austria	18.7	Italy	14.7	Germany	12.6	Belgium	11.1	64.0
Latvia	Sweden	34.1	Norway	9.1	Lithuania	3.9	Serbia	3.4	60.0
Moldova	United States	18.8	British V.I.	16.1	Italy	7.9	France	6.3	56.0
Ukraine	Russian Fed.	13.3	Austria	7.9	Italy	7.1	France	6.7	49.8
Turkey	Spain	10.7	Italy	7.9	Greece	3.8	Belgium	3.3	34.1
Belarus	Russian Fed.	17.9	Austria	5.5	France	1.4	Cyprus	0.6	25.9
Slovenia	Italy	10.1	Austria	7.6	France	5.2	Russian Fed.	1.8	25.8
Russian Fed.	Italy	2.3	France	2.3	Austria	1.4	Netherlands	1.0	14.7

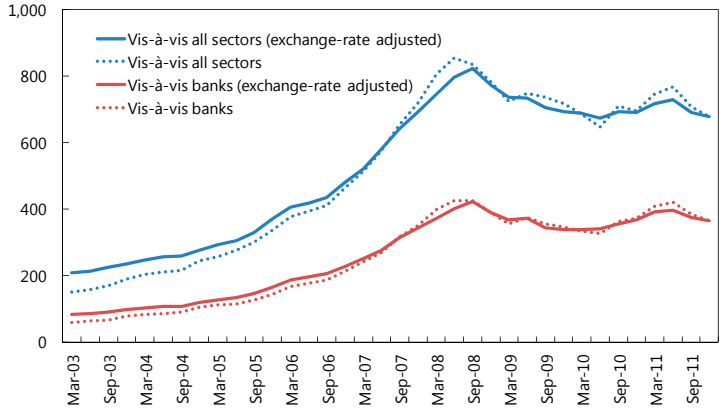
Source: Bankscope and Fund Staff Calculations.

7. **These banking sector linkages played a pivotal role in the severe boom-bust much of CESEE went through in the past decade.**

- In the years preceding the 2008/09 crisis, Western European parent banks financed the rapid expansion of domestic credit that fuel and asset price and domestic demand boom. Cross-border exposure of BIS-reporting banks to the region increased rapidly (Figure 2, bottom right).

- When these bank flows suddenly stopped in the wake of the global financial crisis, the region plunged into a deep crisis. With rapid credit growth coming to a sudden stop, asset price and domestic demand booms came to an abrupt end. Over the next year and a half, cross-border exposure to the region declined peak-to-trough by about a quarter on average—in some countries up to 40 percent (Figure 3, Table 3).

Figure 3. Exposure of BIS-Reporting Banks to Emerging Europe
(Billions of US dollars)



Source: BIS, locational banking statistics.

Table 3. CESEE Countries: Decline in Cross Border Exposures During the Crisis, Exchange Rate Adjusted

	Decline Beginning at End of	Length of Decline (in Quarters)	Decline in Total Exposure (in Percent)
Moldova	2008Q4	12	51.2
Ukraine	2008Q3	13	49.5
Slovak Republic	2008Q4	1	41.8
Estonia	2008Q4	12	40.8
Russia	2008Q3	7	38.8
Latvia	2008Q4	12	36.2
Lithuania	2008Q4	12	35.0
Hungary	2008Q3	13	34.7
Czech Republic	2008Q2	8	24.8
Belarus	2008Q4	3	23.8
Bosnia and Herzegovina	2009Q1	10	23.7
Romania	2008Q4	12	20.8
Slovenia	2008Q4	12	20.8
Albania	2008Q4	1	18.5
Serbia	2008Q2	3	15.9
Montenegro	2009Q4	8	15.8
Turkey	2008Q3	4	14.6
Poland	2008Q2	3	12.0
Bulgaria	2008Q4	6	11.8
Croatia	2009Q3	4	8.3
Macedonia, FYR	2008Q4	2	5.2
Memorandum Item:			
CESEE (Unweighted Average)		7.8	26.9

Sources: BIS locational statistics; and Fund staff calculations.

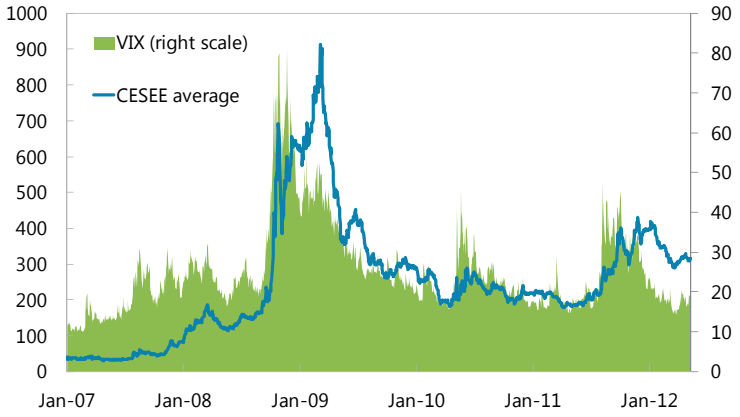
8. From a Western European perspective, bank linkages with CESEE are important for Austria and Greece. While Western European banks dominate CESEE banking systems, their operations in the region represent only a small fraction of their home country's GDP. Austria and Greece represent two exceptions. Consolidated claims of Austrian banks on CESEE at end-2011 were equivalent to 65.8 percent of Austrian GDP; for Greek banks the figure is 25.9 percent of GDP.[7] For Austrian banks, CESEE is also important in terms of profits, with almost half of all profits in 2010 coming from their subsidiaries.

[7] Consolidated claims on CESEE countries amounted to around 30 and 15 percent of total system assets at end-2010, for Greek and Austrian banks, respectively.

Other Financial Market Linkages

9. **Rising risk aversion in Western Europe quickly spills over to CESEE through the CDS market**. When global risk aversion, as measured by the VIX index, rises CDS spreads in CESEE typically follow suit (Figure 4).[8] This not only raises financing costs for the sovereign, but also for the private sector, as funding costs for foreign banks are typically a mark-up over Western European short-term interest rates, with the mark-up closely linked to the sovereign CDS spreads for the CESEE host country.

Figure 4. CESEE Five-Year Average Sovereign CDS Spreads (in basis points) and the VIX Index



Source: Datastream.

10. **Econometric analysis suggests that a rise in CDS-spreads in the euro area periphery only affects CDS spreads through its impact on global risk aversion**. Rising concerns about Greece raises CDS spreads in CESEE because it increases global risk aversion; not because it raises specific concerns about CESEE.

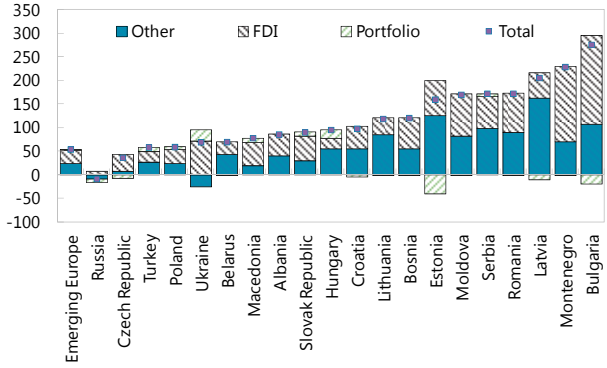
11. **Spillovers in risk aversion from Emerging to Western Europe have become less important in the last few years**. During the 2008/09 crisis when CDS spreads in many CESEE countries were very high, concerns about CESEE affected countries in Western Europe. CDS spreads in Austria, for example, rose because of the large exposure of its banking sector to the region. However, as fundamentals in the region improved, CDS spreads declined, and differences across countries have become much smaller.

12. **Bond markets are less integrated with the west, although Poland, Hungary, and Turkey are notable exceptions**. Few countries in the CESEE region have sufficiently liquid government bond markets and consequently, foreign ownership of domestically issued bonds in most countries is generally low. This also reflects the relatively low level of indebtedness of most countries in the region. Poland, Hungary, and Turkey are exceptions. In Hungary, more than 40 percent of government bonds are held by foreigners. In Poland the figure is about 30 percent. This makes the countries vulnerable to a sudden pull-out of foreign investors. In the fall of 2008, the large scale pull-out of foreigners from government bonds, prompted Hungary to approach the IMF for balance of payments assistance.

[8] While the VIX is not an indicator of risk aversion in Western Europe, much of the movements in the VIX in recent years have been the result of developments in the euro area.

13. **More broadly, portfolio flows have been a relatively unimportant component of capital flows to most CESEE countries.** Even in Hungary, a relatively large recipient of portfolio inflows, they were much smaller than FDI and "other" capital flows (Figure 5).

Figure 5. CESEE: Net Capital Flows, 2003-08
(Percent of 2003 GDP)

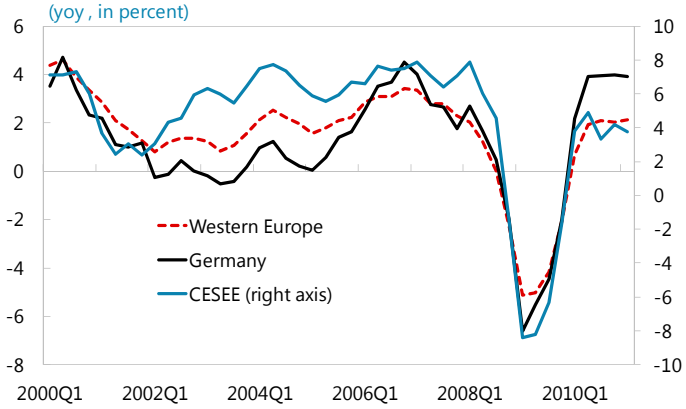


Source: IMF, WEO database

Spillovers—A Quantitative Assessment

14. **These tight linkages imply that shocks originating in Western Europe can have a big impact on CESEE.** It is well known that the 2008/09 crisis in CESEE was in large part the result of spillovers from the crisis in Western Europe (Figure 6), while a revival of exports to Western Europe was instrumental in CESEE's subsequent recovery.

Figure 6. Real GDP growth in CESEE, Germany, and Western Europe
(yoy , in percent)



Sources: Haver Analytics.

15. **What may be less well known is that shocks emanating in CESEE are increasingly felt in Western Europe as well**. Germany's export growth during the pre-crisis years was boosted by strong demand from CESEE; while the sharp contraction in CESEE in 2009 exacerbated the German downturn. Spillovers of the crisis in CESEE were felt in Austria in early 2009, as worries about the large exposures of Austrian banks to the region led to a sharp increase in CDS spreads of Austrian parent banks.

16. **Financial and trade spillovers also interact, as shocks to financial flows from Western Europe to CESEE are soon felt in trade flows.** For example, during 2003–08, much of the ample financing made available by Western Europe's banks to CESEE was spent on imports from Western Europe. The more financing CESEE European countries received from Western European banks, the stronger their imports from Western Europe grew. An estimated 57 cents per euro of western bank financing ended up being spent on imports from Western Europe.

17. **Empirical analysis confirms that the tight economic and financial linkages give rise to quantitatively important spillover effects**. Shocks emanating from Western Europe tend to be felt one-for-one in CESEE. In addition, key countries in Western Europe, such as Germany, Austria, or Sweden, play a "gatekeeper" role for CESEE, transmitting global economic and financial shocks to the region. Apart from spreading shocks, tight linkages have boosted efficiency across Europe, thereby lifting potential growth in Western Europe and CESEE alike.

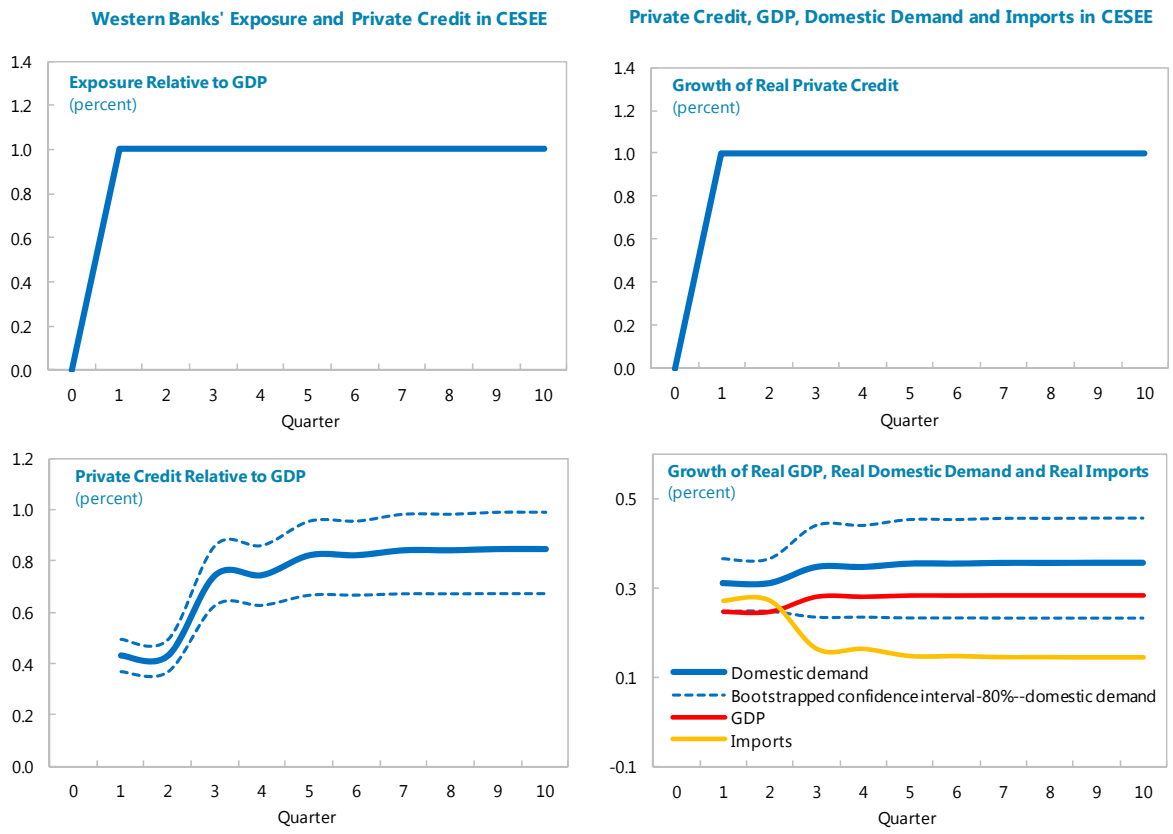
18. **The trade channel alone gives rise to strong spillovers**. The trade model first estimates the effect of output shocks on import demand and then uses historical import shares to calculate the impact on trading partner's exports. Export multipliers are set to one, essentially assuming that income effects and leakage from the imported inputs embedded in exports offset each other. In this setting, a shock of 1 percent to Western Europe's GDP adds 0.4 percent to output in CESEE on average. The effect is much larger in small open economies, such as Estonia or the Slovak Republic, than in larger, more distant economies, such as Russia. Conversely, a 1 percent shock to CESEE's GDP entails only 0.1 percent extra output in Western Europe, reflecting primarily the smaller size of CESEE's economy.

19. **Banking linkages are an important separate conduit for spillovers**. The cross-border banking model finds that a 1 USD change in cross-border exposure of western banks vis-à-vis CESEE banks translates over time into a 0.8 USD change in domestic credit.[9] And each extra percentage point in real credit growth adds about 0.3 percentage point to real GDP growth (Figure 7). This suggests that the financing provided by western banks during 2003–08 added 1½ percentage points to CESEE's annual GDP growth, pushing it to 6½ percent per year

20. **Overall spillovers are bound to be larger than the summed effects from trade and banking channels**. First, these two channels are likely to reinforce each other. A financial shock emanating from Western Europe boosts funding of CESEE's banking systems, their credit provision, and aggregate demand. This stimulates exports and economic activity in the west, given that some 60 percent of the financing provided by western bank to CESEE tends to be spent on imports sourced from Western Europe. Second, additional spillover channels are likely at play. This includes remittances of CESEE expatriates working in Western Europe and hard-to-quantify confidence channels that give rise to co-movements of CDS spreads, bank funding costs, and asset prices.

[9] This result is for the group and does not apply to every individual country.

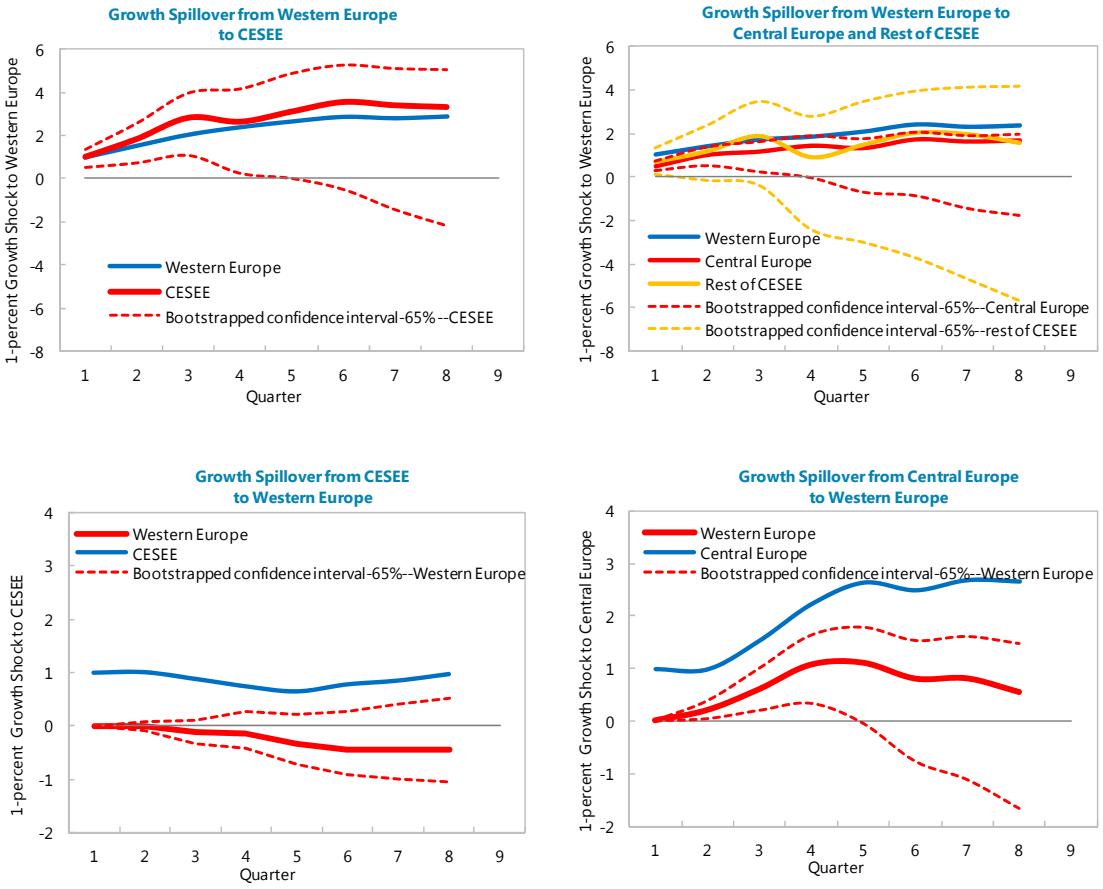
Figure 7. Europe: Credit Spillovers from Western Europe to CESEE [1]



Sources: BIS, Locational Banking Statistics (Table 6); IMF, *International Financial Statistics*; IMF, World Economic Outlook database; and IMF staff calculations.

21. **Overall, a one percent growth shock in Western Europe gives rise to a shock of about equal size in CESEE**. This result is derived from a VAR model that explains growth in Western Europe and CESEE in terms of past growth in the two parts of Europe while controlling for growth in the rest of the world. By design this setup is agnostic about the precise nature of transmission channels and can therefore be seen as a summary measure of spillovers. Extra growth in Western Europe translates into extra growth in CESEE in about the same amount and with little delay (Figure 8). CESEE's economic integration seem on average not yet strong enough to support a significant impact of CESEE growth shocks on Western Europe's output. However, more tightly integrated Central Europe appears to already have a measurable impact on growth in Western Europe.

Figure 8. Europe: Growth Spillovers between CESEE and Western Europe[1]
(Accumulated response of GDP, percent)



Sources: IMF, World Economic Outlook database; and IMF Staff calculations.

22. **In addition to being an original source of spillovers, Western Europe also acts as a conduit for the transmission of global shocks to CESEE**. These effects are not captured by the above VAR analysis because of controlling for global growth shocks. However, an economic upswing outside Europe is bound to spur German exports with positive knock-on effects for the CESEE countries hosting Germany's "extended work bench." More formal network analysis identifies "clusters" of countries closely interlinked and "gatekeepers"—economies that provide a key nexus of the cluster with the rest of the world. Germany, Italy, and Austria are found to be gate keepers for a number of CESEE countries. Similarly, Sweden acts as a gatekeeper for the Nordic-Baltic cluster.

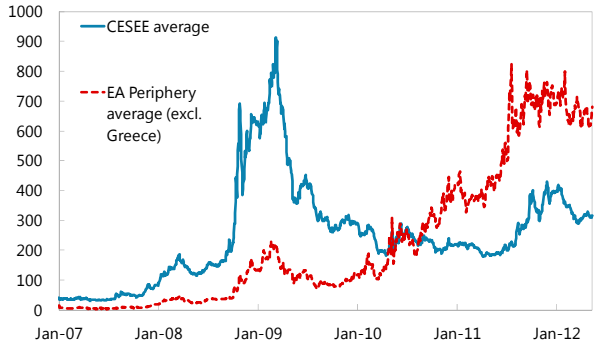
Spillover Risks from the Euro Area Crisis

23. **Given the close linkages between Western Europe and CESEE, an intensification of the euro area crisis is a major risk for the CESEE region**. If tensions in the euro area were to escalate further, CESEE would be severely affected through both trade and financial channels. Exports would suffer if euro area growth declined rapidly; financial markets strains would intensify, parent bank funding would likely be scaled down and capital inflows would drop, further affecting domestic demand. Initially, the CESEE region felt little impact of the crisis, as the adjustment following the 2009 crisis adjustment had made the region more resilient. But this changed in the summer of 2011, as the crisis started to affect the banks in Western Europe.

Initial impact of euro area crisis-first half of 2010–summer 2011

24. **Until the summer of 2011, there had been little impact of the euro area sovereign debt crisis on CESEE**. While CDS spreads in peripheral Western Europe went up steadily, spreads in CESEE remained flat or continued to decline, as the region recovered from the deep recession of 2008/09 (Figure 9).

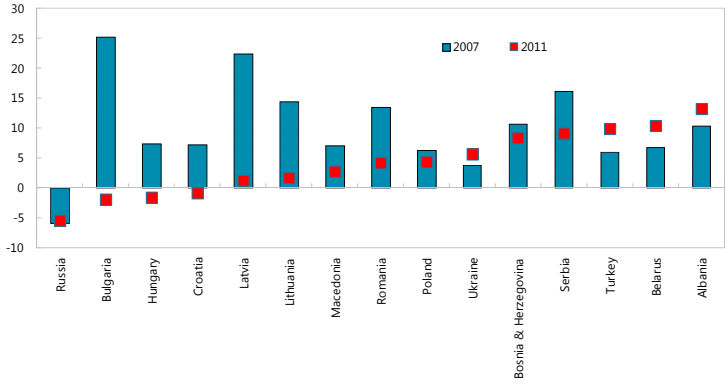
Figure 9. Five-Year Average Sovereign CDS Spreads (in basis points)



Source: Datastream.

25. **The increased resilience of the CESEE region to financial market contagion since the global crisis in 2008–09 is likely the result of the correction of large internal and external private sector imbalances**. In 2008, the region was very vulnerable to a sudden stop in capital inflows as current account deficits were high (Figure 10) and growth had become dependent on the continuation of large capital inflows. By 2011, much of these imbalances had disappeared: high current account deficits were no longer an issue in most countries (with the notable exception of Turkey), economies were no longer overheating, and growth was increasingly being driven by exports rather than capital-flows fueled domestic demand booms.

Figure 10. Emerging Europe: Current Account Deficits
(Percent of GDP)



Sources: National authorities; and IMF staff estimates.

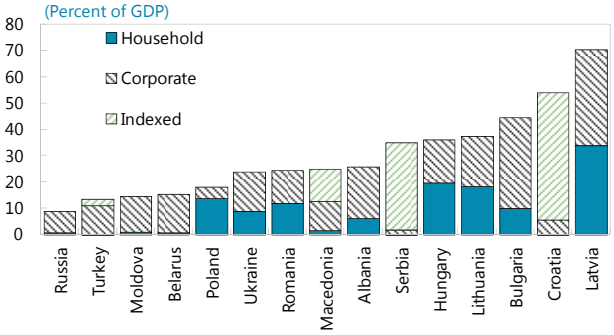
26. **Sharp adjustment of fiscal imbalances in CESEE further contributed to declining vulnerabilities**. CESEE's public finances were hit hard by the 2008/09 crisis, as the end of the domestic demand booms led to a sharp drop in government revenues, and the region-wide fiscal balance swung from a surplus of 1½ percent in 2007 to a deficit of 6 percent in 2009. Most

countries went through painful fiscal adjustments, and by 2011, the deficit in the region had been reduced to ½ percent of GDP.

27. **The decline in vulnerabilities of CESEE was rewarded by the improvement of CDS spreads relative to Western Europe**. By 2011, there was no longer a clear distinction between CESEE countries and Western Europe. CDS spreads in Russia were lower than in France; spreads in Bulgaria and Romania were lower than in Spain and Italy; and spreads in Estonia were lower than in Belgium.

28. **Yet despite these improvements, several vulnerabilities remain high**: financing requirements are high, large stocks of foreign currency loans constrain exchange rate and monetary policy (Figure 11), and Russia and Ukraine remain vulnerable to drop in commodity prices.

Figure 11: CESEE: Stock of Foreign Currency Loans, December 2011
(Percent of GDP)



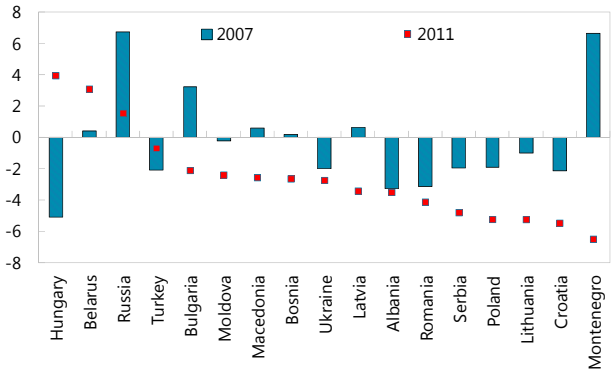
Sources: IMF, *International Financial Statistics*; and IMF, World Economic Outlook database.
Note: No breakdown between corporate and household is available for indexed loans.

29. **Moreover, as a result of the 2009 crisis, a number of new vulnerabilities have emerged** (high NPLs and large fiscal deficits), which have only partially been addressed. Fiscal deficits are still high in a number of countries (Figure 12), despite considerable consolidation.

Summer 2011 and beyond—CESEE Feels Contagion

30. **The continued susceptibility of CESEE to the euro area crisis was laid bare in the second half of 2011 when the stress in the west escalated and CESEE countries started to suffer from contagion through bank funding and exchange rate channels**. When the crisis in Western Europe intensified, and CDS spreads of large Western Banks in the region widened, sovereign CDS spreads in the region increased (Figure 13), currencies came under pressure, and deleveraging by parent banks picked up. The degree to which countries were affected was not uniform, but depended on underlying vulnerabilities. Spreads became particularly elevated in Ukraine and Hungary.[10]

Figure 12. CESEE: Fiscal balances: 2007 and 2011
(Percent of GDP)

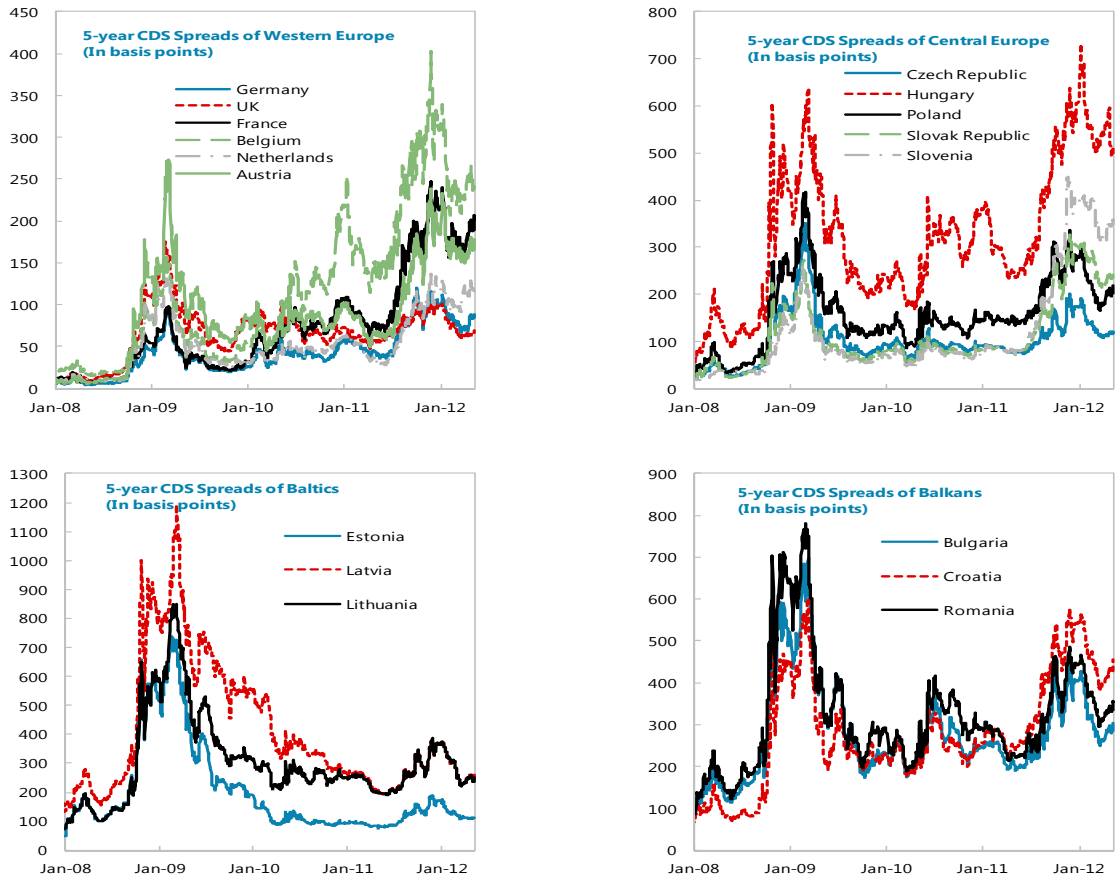


Source: IMF, WEO database

[10] The variation in CDS spreads across countries remained, however, much lower than during the 2008–09 crisis. A generalized variance decomposition analysis suggests that idiosyncratic, country specific factors explain the more elevated level of CDS spreads in Ukraine and Hungary.

31. **Euro area banks came under significant funding pressure, which triggered significant deleveraging from CESEE in the second half of 2011**. BIS reporting banks reduced their exposure to CESEE by 6½ percent between June and December, compared with about 3 percent for the Africa and Middle East and Asia Pacific regions and an increase of 2 percent in Latin America and the Caribbean.

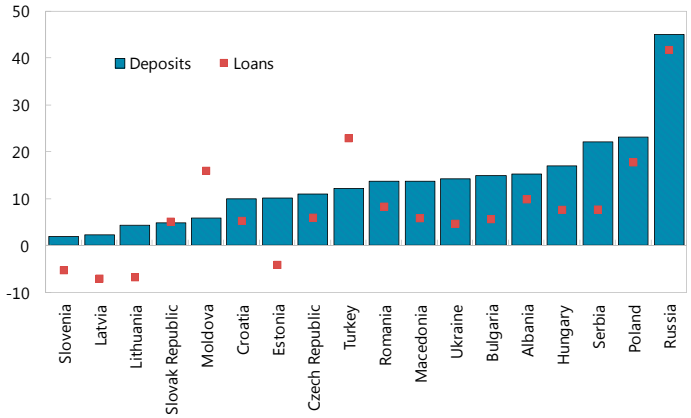
Figure 13. Europe: 5-year CDS spreads



Source: Bloomberg.

32. **The impact on credit growth was less pronounced, becoming negative only in the Baltics and Slovenia**. The reduction in foreign claims in 2011H2 was only a quarter of the reduction in cross-border exposures, suggesting that local affiliates of western banking groups have partly substituted domestic funding for lost cross-border funding.[11] Adjusted for exchange rate changes, foreign claims of BIS-reporting banks declined by 1½ percent in 2011H2, compared with a 6½ percent decline in cross-border exposures. In Bulgaria, the Czech Republic, Lithuania, Montenegro, Poland, and Serbia foreign claims increased, despite a reduction in cross-border exposure, presumably because credit growth was funded from local deposit growth. In some countries the impact on overall credit growth has been further mitigated by local banks stepping up credit.[12] Overall, credit contracted only in the Baltics and Slovenia, and domestic credit in the region grew at an annualized rate of about 6 percent in 2011H2 (Figure 14). [13]

Figure 14. Change in Deposits and Loans, 2011H2
(Annualized, in local currency, percent)



Source: IMF, *International Financial Statistics*; and IMF staff calculations .

33. **The introduction of the ECB's three-year LTROs helped stage a recovery in financial sentiment from mid-December**. IFS data for the first months of 2012 suggest that exposure reduction of Western banks to the CESEE region has not continued in 2012. In addition, portfolio flows to the region, which had been negative in the third and fourth quarter, became positive again in the first quarter.

34. **Despite the better tone in financial markets, growth in the region is expected to slow sharply this year, and downside risks are significant**. The Spring 2012 WEO projects 2012 growth in CESEE of 2.9 percent, compared to 4.7 percent in 2011. The outlook for Southeastern Europe and Hungary is particularly weak. Moreover, tight trade and financial linkages with the euro area keep the region vulnerable to a renewed deterioration in the euro area.

[11] The foreign (consolidated) claims include all assets of subsidiaries (including assets funded from local deposits and other forms of local funding); the locational statistics only include cross-border claims. In the Czech Republic, foreign claims are high, as the banking system is largely foreign owned, but cross-border claims are not, as domestic credit is mostly funded from domestic deposits.

[12] This was particularly notable in Russia, where despite a reduction in foreign claims, overall credit growth remained strong.

[13] Unweighted average. Note that the changes in the stock of outstanding loans and deposits partly reflect currency movements. Belarus has been excluded from the average and from the chart, due to its very high inflation.

35. **Risks remain significant.** If tensions in the euro area were to escalate further, CESEE would be severely affected through both trade and financial channels. Exports would suffer if euro area growth declined rapidly; financial markets strains would intensify, parent bank funding would likely be scaled down and capital inflows would drop, further affecting domestic demand. Banking linkages may in particular create negative spillovers if the crisis intensifies. Western European banks' need to deleverage would increase substantially if the euro area crisis re-intensified. The potential for negative spillovers from Italian and Greek banks is particularly high.

36. **Foreign ownership of banks has so far played a stabilizing role during episodes of funding stress (Box 1) but it may not continue to do so going forward**. Market funding to Western European parents has become scarcer and their ability to fund their CESEE affiliates has been impaired. The ECB's LTROs have provided significant but temporary relief. In addition, Basel III, EBA requirements, and financial markets' expectations in terms of higher capital quality may force prolonged deleveraging among several large Western European banks and reduce their ability and willingness to keep exposures to CESEE countries.

37. **Advanced Europe is also less in a position to provide a strong backstop for problems that might surface in CESEE**. Weakened western banks might be reluctant provided large-scale support in the event of a bank runs in a CESEE country. To compound the problem, public finances in Western Europe have fewer buffers to extend aid to CESEE.

Policy Implications

38. **Close linkages between emerging and advanced Europe have benefited both regions, but they naturally also make both regions more susceptible to shocks originating elsewhere in Europe**. Shocks in advanced Europe quickly spillover to CESEE, but spillovers increasingly go both ways, and financial shocks one way quickly translate into trade shock going other way.

39. **Policy formulation needs to take interconnectedness into account, including through cooperation across borders**. Interconnectedness needs to be fully recognized and understood. Buffers need to be sized so as to be able to absorb shocks originating elsewhere. Risk management frameworks need to be designed to deal with the complexities in an interconnected world, including closer cooperation of policy makers in home and host countries.

40. **Reducing remaining home-grown vulnerabilities may make CESEE countries more resilient to euro area turmoil**. It is noteworthy that sovereign CDS spreads have not increased across the board. Financial markets are increasingly differentiating across countries. Those that have made less progress in addressing country-specific vulnerabilities have been more affected by pressures than other countries.

Box 1. Is Foreign Bank Ownership Stabilizing in CESEE?

Economic intuition suggests that foreign bank ownership should have a stabilizing influence during periods of funding stress. Loans to subsidiaries are much closer to equity capital, and not providing subsidiaries with sufficient funding may reduce the value of parent banks' franchise. In practice, however, the link between foreign ownership and reduction in cross-border exposure is not as clear cut. During the crisis of 2008/09, for example, Russia and Estonia both experienced a 38 percent reduction in cross order exposure, even though Russia has a low share of foreign banks (14 percent) and Estonia a high one (80 percent).

Econometric analysis confirms that foreign ownership reduces deleveraging during crisis time, but does not make a difference during normal times, when aggregate external funding increases. A regression of the quarterly percentage change of cross-border exposures on macro-financial indicators during the period between 2007Q1 and 2011Q3 shows that during periods of stress, higher shares of foreign ownership help shield economies from aggregate funding declines. In crisis times, the difference in change in cross-border exposures between a country with 20 percent foreign ownership and one with 80 percent foreign ownership is 2.3 percentage points per quarter. Lower CDS spreads and higher banking sector ROA help mitigate funding declines as well: a 100bps change in CDS level translates into a quarterly change of 0.1 percentage point in funding, while a change in ROA by 1 percentage point translates into a quarterly change of 0.7 percentage point. By contrast, short-to-medium-term growth prospects (captured by the WEO 3-year growth forecast) and reliance on external funding (captured by the loans-to-deposits ratio) do not seem to matter.

Determinants of International Funding Risk

		Model 1 1/
GDP forecast (t-1, %)	No crisis	0.902
		(0.778)
	Crisis	-0.021
		(0.562)
5Y CDS (t-1)	No crisis	0.008
		(0.006)
	Crisis	-0.001**
		(0.000)
Loan/deposits (t-1, %)	No crisis	0.001
		(0.014)
	Crisis	0.006
		(0.012)
Bank ROA (t-1, %)	No crisis	2.411***
		(0.706)
	Crisis	0.716***
		(0.204)
Foreign control (t-1, %)	No crisis	-0.004
		(0.019)
	Crisis	0.038**
		-0.017
Constant		-5.811
		(3.960)
Memorandum Items:		
R-squared		0.334
Observations		149
Estimator		OLS

Sources: BIS, IMF, Bloomberg, Local Authorities and Fund Staff Calculations

1/ * p<0.10, ** p<0.05, *** p<0.01, s.e. in Parentheses,
Crisis = 2008Q4-2010Q2 and 2011Q3

7. Financial Spillovers from Euro Area and UK Global Systemically Important Banks (G-SIBs)[1]

Building on last year's spillover reports, this paper assesses the role of European banks, notably euro area and UK global systemically important banks (G-SIBs), as sources and propagators of shocks. The analysis identifies four euro area and two UK banks as having high capacity to generate spillovers. Some of these banks are also found to be very vulnerable to funding and sovereign stress. Thus, an intensification of the euro area crisis is likely to have large amplifying effects via its G-SIBs.

Motivation and Objectives

1. **European G-SIBs have grown in size and importance and are highly interconnected with the rest of the global financial system**. Their assets have more than tripled since 2000, amounting to $27 trillion in 2010 (Figure 1).[2] Furthermore, European G-SIBs tend to be larger (including relative to home country GDP) and more leveraged than their US and Asian peers.[3] As key players in global derivatives and cross-border interbank markets, they are also among the most interconnected G-SIBs.

2. **Therefore, financial spillovers—both within the region (inward) and to other regions (outward)—from region-specific shocks transmitted through European G-SIBs could potentially be very large**.[4] To gauge the scope for financial contagion within and outside Europe, this note addresses two questions: (1) How are G-SIBs interconnected and what are the main conduits and recipients of outward spillovers? (2) If European banks were hit by a sizeable sovereign or funding shock, what would be the impact of deleveraging across countries and regions?

3. **To help answer these questions, the analysis utilizes two complementary approaches**. In the absence of data on banks' bilateral exposures, correlation-based measures of market prices and low-frequency balance sheet data are used to assess interconnectedness and contagion channels through risk exposures. This allows a real-time analysis of international financial linkages among G-SIBs. The second approach makes it possible to examine the channels of transmission of

[1] Prepared by Eugenio Cerutti (RES), Anna Ilyina (MCM), Srobona Mitra (MCM), Marta Ruiz-Arranz (EUR), and Thierry Tressel (EUR).

[2] The global banking system assets are proxied by a sample of around 260 banks domiciled in 25 jurisdictions with systemically important financial sectors (see, IMF (2010)).

[3] In part, this is because European banks tend to follow the universal banking model, which combines a range of retail, corporate, and investment banking activities under one roof. It should also be noted that there are some accounting differences that would make the balance sheets of the IFRS-reporting banks appear more "inflated" than the balance sheets of banks reporting under the US GAAP (e.g., netting of derivative and other trading items is only rarely possible under IFRS, but netting is applied whenever counterparty netting agreements are in place under US GAAP). That said, the use of data adjusted for accounting differences does not change the results of the analysis.

[4] In this note, "outward spillover" refers to the potential impact of an institution's distress or failure on other institutions and "inward spillover" refers to the vulnerability or susceptibility of a given institution to the distress or failure of other institutions.

various shocks and evaluate their impact, but at the expense of moving to a more aggregate, banking-system level.

Interconnectedness and Spillovers: Some Diagnostics

4. **G-SIBs are linked through a complex network of international financial exposures**. To assess interconnectedness and contagion channels of such exposures, we use five market price-based measures—simple correlations, average directional correlations, and two types of directional spillovers during extremely negative scenarios—as well as a balance-sheet measure of interconnectedness (Appendix I).

5. **Market perception of interconnectedness typically increases in times of stress**. A straightforward way to examine connectedness is by means of simple correlations, although such an approach will not help differentiate spillovers owing to institutions' exposures to common risk factors from those due to direct or indirect exposures between institutions. Two key findings are noteworthy, based on rolling pair-wise correlations of expected default frequencies between each of the UK and EA SIBs and the other financial institutions. First, there is limited co-movement in expected default probabilities (EDFs) over time, except during stress episodes, such as the Lehman collapse or the intensification of the euro area crisis in late-2011. Second, more recently, co-movements of CDS spreads and EDFs spiked in late 2011—close to Lehman levels—and remain elevated for all UK and EA G-SIBs. Moreover, while spillovers to US banks remain relatively large, contagion to Japan has remained contained during the EA crisis (Figure 2).

6. **Among European banks, six G-SIBs are identified as having high capacity to generate spillovers for all G-SIBs as well as for other large European banks**.[5] These include French, German, and UK banks. While most of these G-SIBs have high capacity to generate spillovers for all G-SIBs, on average and in times of extreme market stress, some G-SIBs have a high spillover potential mainly during extreme market stress. Moreover, the core euro area G-SIBs with high spillover potential also have significant exposures to market, credit (including in the euro periphery), and funding risks, while their capital ratios are moderately above the EBA's 9 percent core Tier 1 capital requirement and below those of global peers.

7. **The main recipients of outward spillovers from these institutions include other European and US G-SIBs** (Figure 3). Outside Europe, two US G-SIBs would be significant recipients of outward spillovers. By contrast, Asian G-SIBs are not as affected. Many of the same institutions that generate outward spillovers are also susceptible to spillovers from other European SIBs (notably some French, Italian, and Spanish ones).

[5] The analysis uses publically available data, but names are withheld due to its sensitivity.

The Transmission of Shocks through SIB Balance Sheets: Scenario Analysis

8. **By propagating the impact across financial systems, adverse shocks to European G-SIBs balance sheets could have significant effects within and outside Europe.** Two such shocks include: (1) a sudden freeze of wholesale markets; and (2) a sustained decline in prices of peripheral sovereign bonds.[6] Their spillover effects are computed using a global model of bank balance sheets, which assumes that European banks maintain a target minimum Tier I capital ratio of 10 percent by contracting their balance sheet ("deleveraging") in the face of sudden losses that cannot be absorbed by existing capital buffers.[7] See Appendix II for details on methodology.

9. **The deleveraging impact of a sizeable funding shock would be large, both in Europe and in other regions**.

- *How large is the shock*? Unsecured and secured wholesale funding markets are assumed to be under severe stress. As a result of a sharp increase in counterparty risk, funding costs in euro and US$ wholesale markets are assumed to increase by 130 bps (The shock corresponds to the average increase in the Euribor-OIS spread of 1, 3, and 6 months maturities between September 2008 and mid-October 2008). The loss of confidence is also assumed to prompt a decrease of 250 bps in the value of derivative market funding.[8]

- *Which are the most vulnerable G-SIBs*? In absolute terms, the combined shocks would affect French, UK and German banking systems the most.

- *Which SIBs are likely to propagate the shock?* The main drivers of deleveraging would be French, British, and German banks. Because French, UK, and German SIFIs have large absolute amounts of bank liabilities, the initial shock would be amplified through interbank exposures (Figure 4). French banks would be the most affected, as losses would eventually reach 22 percent of Tier I capital, followed by Belgium (20 percent of Tier I capital), German (17 percent), Swedish and Danish (15 percent) and UK banks (13 percent). Other euro area banks, including those from the periphery would be, in relative terms, somewhat less affected by the funding shock.

- *Which European borrowers are most vulnerable?* Assuming no policy reaction, the resulting deleveraging impact would be extremely large, exceeding 30 percent of GDP in the UK,

[6] The shocks are calibrated using SIB-specific data provided as part of the EBA exercise. They are presented separately for illustrative purposes, but they are not necessarily independent of each other.

[7] The 2011 Spillover Report also presented deleveraging scenarios caused by funding and sovereign stress. The shocks presented in this note are however, significantly larger.

[8] The shock calibrated on the EBA sample of banks is extrapolated to the rest of the banking system.

France, Ireland, Spain, and Sweden (Figure 5). It would also affect many EU borrowers, including in emerging Europe.[9]

- *Which borrowers outside Europe would be most affected*? Although not at the same level as in the Euro Area, a noticeable foreign deleveraging impact (of less than 5 percent of GDP) would be faced by borrowers in some developed countries outside Europe (e.g. US, Japan, South Korea, and Australia) as well as in emerging markets (e.g., South Africa, India, Mexico, and Brazil). See Figure 6.

10. **The deleveraging impact following a sovereign shock would be substantial, but more concentrated within Europe.**

- *How large is the shock*? The scenario assumes that sovereign stress in Italy and Spain remains permanently high. This translates into a permanent decline in sovereign bond prices of Italy and Spain equal to the difference between their bond price on December 31, 2011 and March 2, 2012. For simplicity, it is also assumed that all exposures are marked-to-market;[10] and there is a 30 percent haircut on exposures to Greece, Ireland, and Portugal. The size of the shock is such that it has a significant impact on the balance sheets and Tier 1 capital of banks in many high yield countries.

- *Which are the most vulnerable SIBs*? Domestic banks in the periphery and several European SIBs in the core would be severely affected.

- *Which European borrowers are most vulnerable?* In the absence of policy action, the impact of the deleveraging shock would be the largest among borrowers in the periphery because of the strong exposures of domestic banks to their sovereign. The large European economies (UK and Germany) would also be significantly impacted, with a deleveraging shock of almost 10 percent of GDP. As peripheral banks deleverage in non-EMU markets, there are significant spillovers in Southern Europe (Figure 7).

- *Which borrowers are most affected outside Europe?* Some borrowers in Latin America (including Brazil, Mexico, and Chile) would be affected but generally to a lesser degree than European borrowers. Borrowers in the US, Japan, and Asian EMs would remain largely unaffected, although some in the region may suffer a modest impact.

[9] This result differs from the EU bank deleveraging exercise presented in the April 2012 GFSR, which finds the impact of bank deleveraging to be strongest in the periphery of the euro area and in emerging Europe. The GFSR considers a broader range of factors and less extreme shocks than this paper (e.g., the funding shock in the above analysis is calibrated as a prolonged Lehman type event).

[10] The shock is calibrated based on European banks' exposures as disclosed in the EBA recapitalization exercise. The size of the shock corresponds to an average decline in bond price of 20 percent and 10 percent, respectively, for the Italian sovereign and the Spanish sovereign.

Policy Implications

11. **In light of the large contagion effects, policies should be aimed at containing the risks of a G-SIB failure and addressing too-big-to fail issues:**

- A comprehensive set of policies to address the root causes of the euro area sovereign debt crisis would go a long way toward mitigating the underlying fragilities of European sovereigns and banks. In particular, taking bold steps toward the establishment of a banking union for the euro area would help restore financial stability and mitigate spillover risks through G-SIBs.

- In the meantime, a strong common backstop is needed for bank recapitalization (through EFSF/ESM), and ECB liquidity support must continue to be provided as needed. Similarly, given UK banks' vulnerabilities to funding shocks, the Bank of England should stand ready to provide liquidity through a range of facilities if strains from the euro area crisis intensify.

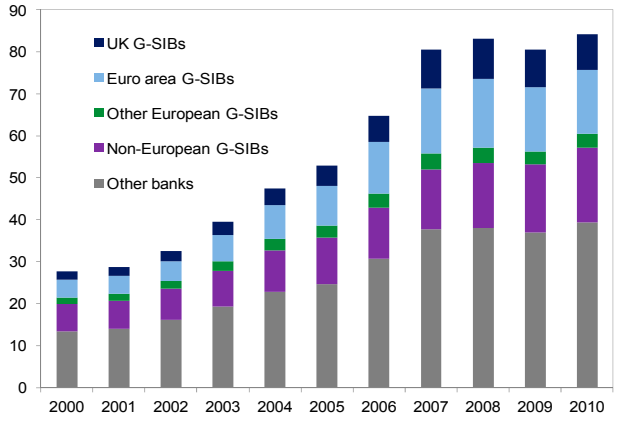
- European SIBs, and especially G-SIBs should continue to strengthen their funding models and capital buffers in order to increase market confidence in their resilience. It is important, however, to ensure that the build-up of additional capital buffers occurs mainly through capital raising and retained earnings rather than asset reduction, which could have adverse impact on the financial system and economic activity. Similarly, strengthening of funding model should not result in excessive and uncoordinated deleveraging.

- A harmonized EU resolution framework for G-SIFIs would ensure orderly resolution and reduce the cost of resolution of large cross-border financial institutions. Progress made in developing recovery and resolution plans for major institutions in the UK is welcome.

- International collaboration will be necessary to further bolster the stability of the financial system. Exchange of key information on a timely basis and cross-border supervisory cooperation are critical to containing risks emanating from large banks.

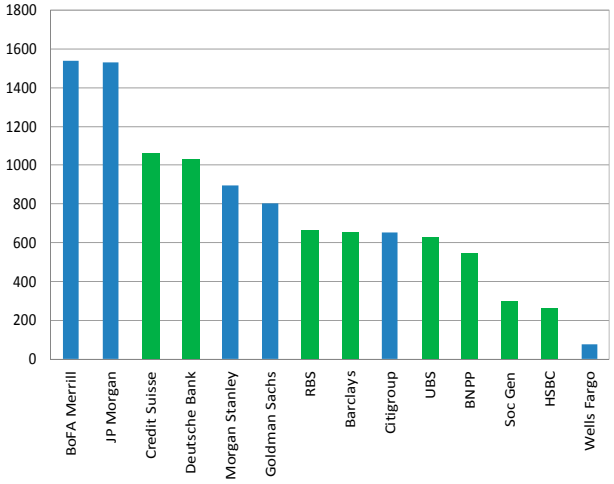
Figure 1. G-SIBs and Other Banks—Some Stylized Facts

Evolution of Total Assets of G-SIBs and other Banks
(in trillion USD)



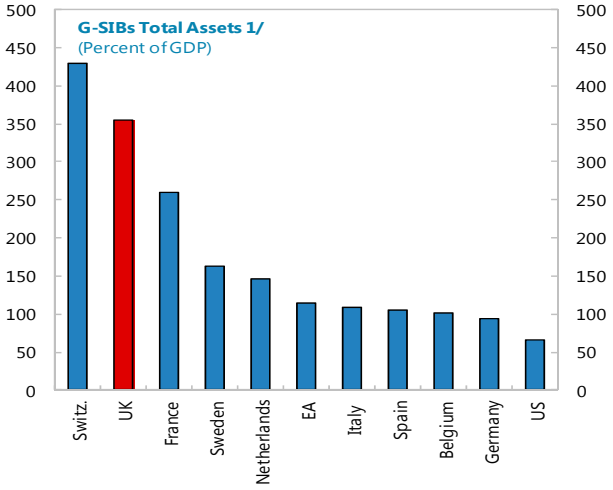
Sources: Bank reports; and Bloomberg
Note: Sample banks include around 260 banks domiciled in 25 jurisdictions with systemically important financial sectors.

Gross MTM Positive Derivative Positions of the 14 Largest Global Derivative Broker-Dealers
(in billion USD, end-2010)



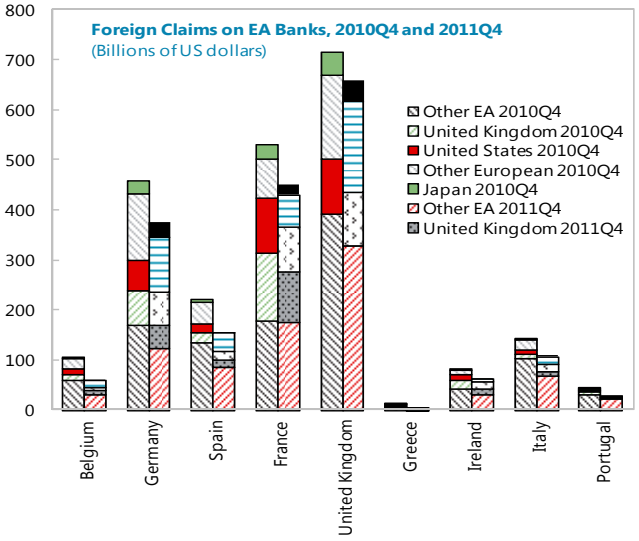
Note: European banks are in green; US banks are in blue; data have been put together by Nadege Jassaud.

Total Assets of G-SIBs
(in percent of GDP)



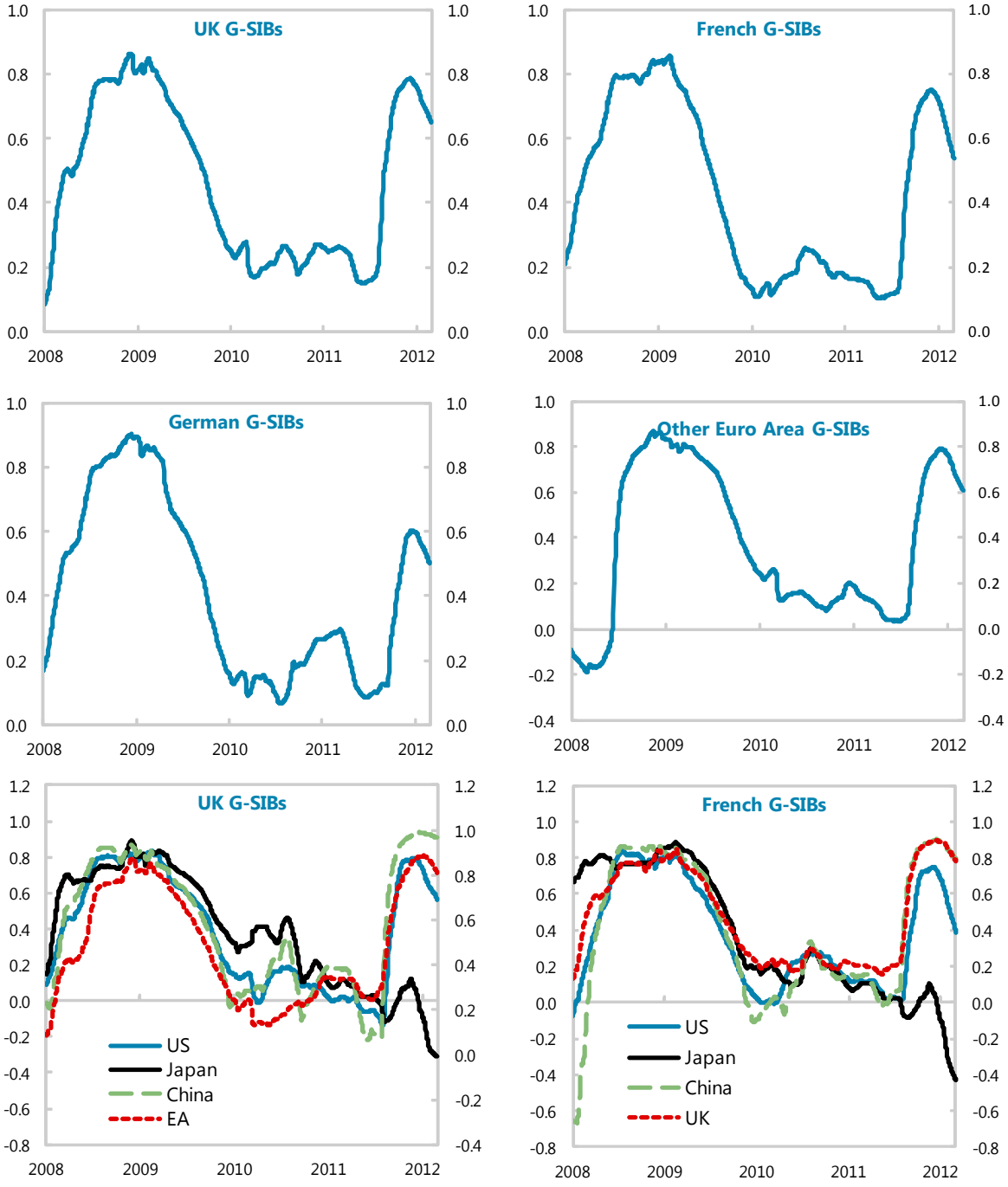
Sources: Annual Reports; Bankscope; and IMF's World Economic Outlook.
1/ G-SIBs total assets by country, except Italy where Unicredit, Intesa San Paolo and Banca Monte dei Paschi di Siena are included. Assets are not adjusted for accounting differences in derivatives.

Foreign Claims on Euro area banks
(in billion USD, end-2010 and 2011)



Source: BIS

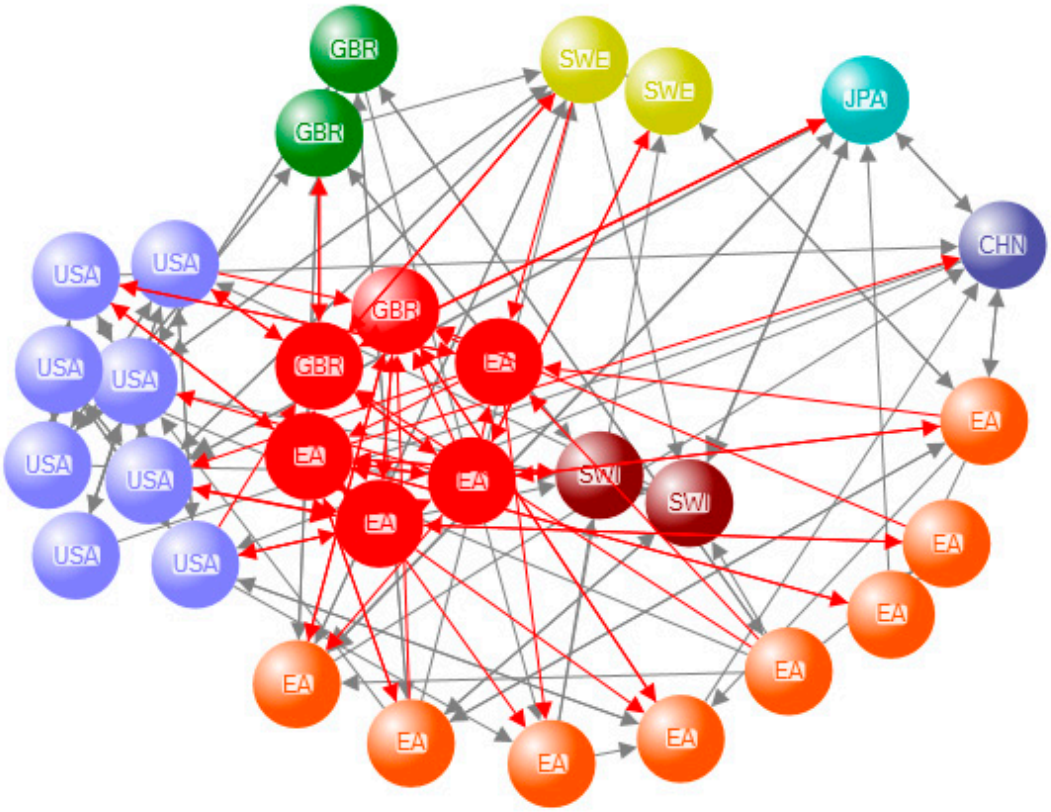
Figure 2. Rolling Correlations among G-SIBs



Source: Moody's KMV, IMF staff estimates
1/ Defined as the average correlation between expected default probabilities (EDF) across all pairs.

Figure 3. Spillovers under Extreme Market Stress (CMO measure)

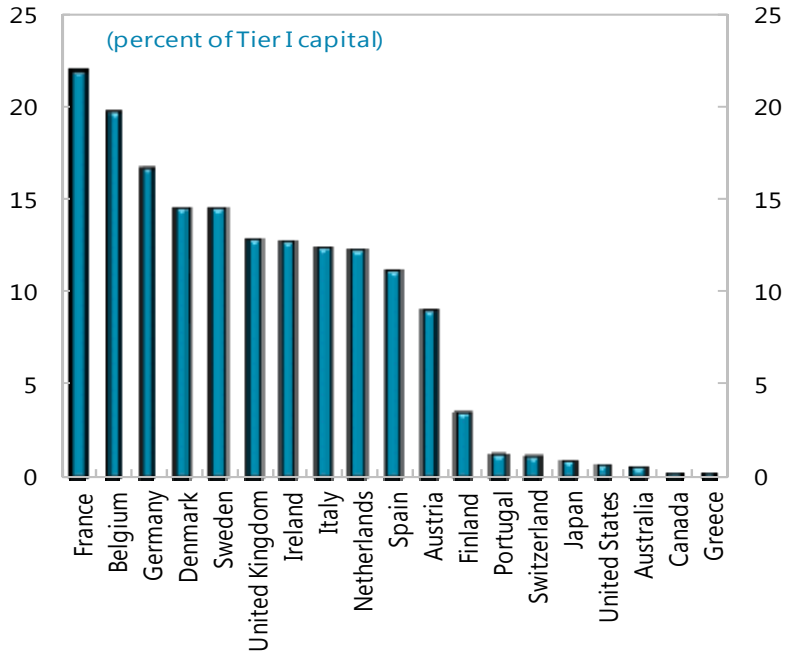
(red arrows indicate spillovers between the six G-SIBs identified as having high a capacity to generate spillovers).



Sources: Bloomberg; and Fund staff calculations using the CMO directional spillover methodology.

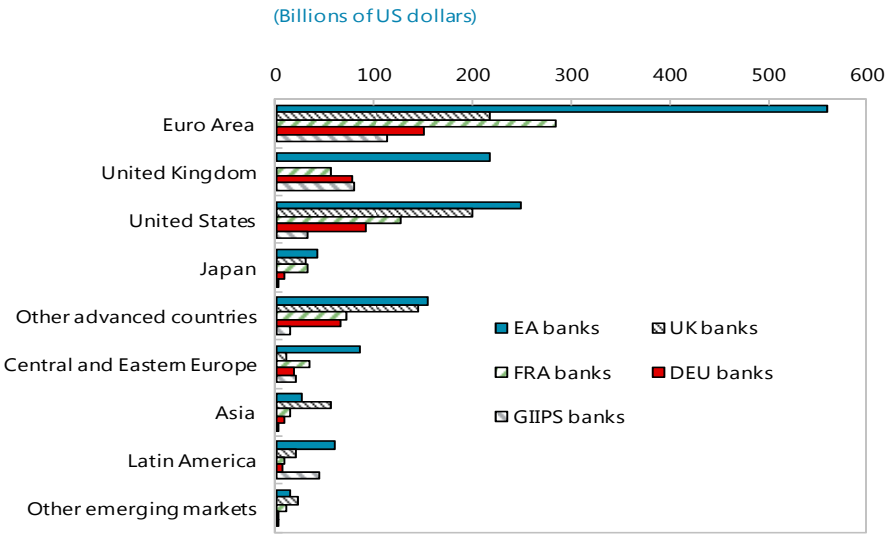
Note: The individual banks are labeled using their home country or region names

Figure 4. Funding Shock: Equilibrium Bank Losses



Sources: Fund staff calculations; BIS; and Bankscope.

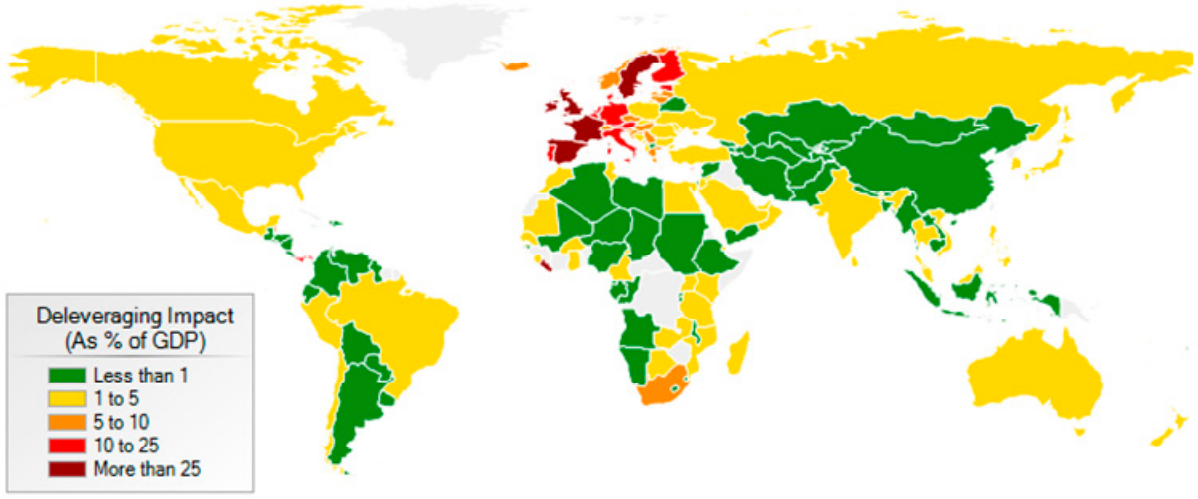
Figure 5. Deleveraging by Banking Systems and by Vis-à-vis Country or Region



Sources: Fund staff calculations; BIS.

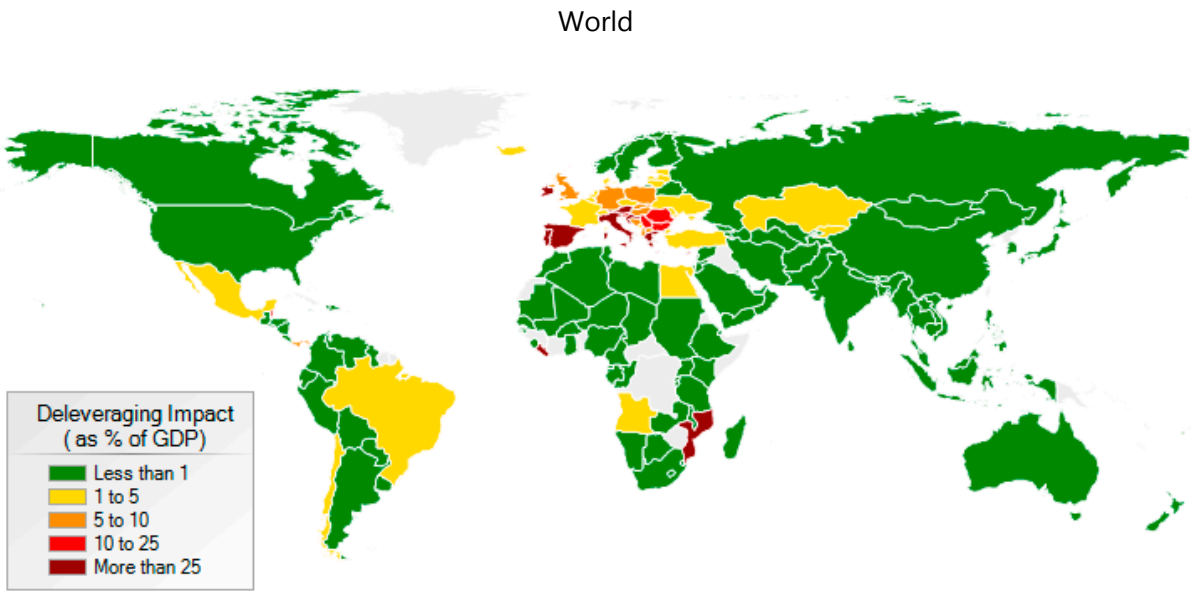
Figure 6. Deleveraging Resulting from Funding Shocks (in percent of GDP)

World



Sources: Fund staff calculations; BIS; WEO.

Figure 7. Deleveraging Resulting from the Sovereign Shock (percent of GDP)



Sources: Fund staff calculations; BIS; WEO.

Appendix I: Data and Methodology

Data

1. The analysis uses data on 32 SIBs—27 G-SIBs and 5 European SIBs that are considered likely to contribute to spillovers within Europe. The 5 SIBs, chosen from a large sample of European SIBs, scored high on the spillover metrics within Europe. The Table below shows the list of 32 SIBs. The equity prices of the 3 Japanese G-SIBs are aggregated into a weighted average, weighted by assets. This decision was taken following earlier analysis suggesting that the extent of spillovers from any one Japanese institution to another G-SIB outside Japan is low in comparison to other G-SIBs.

Appendix Table 1: Sample Banks

European G-SIBs[1]		**Western Hem. G-SIBs**	
BNP Paribas	FRANCE	Bank of America	USA
Credit Agricole	FRANCE	JPMorgan Chase & Co	USA
Societe Generale	FRANCE	Citigroup Inc	USA
Deutsche Bank	GERMANY	Wells Fargo & Co	USA
Commerzbank	GERMANY	Goldman Sachs Group	USA
UniCredit	ITALY	Morgan Stanley	USA
ING Groep	NETHERLANDS	Bank of New York	USA
Banco Santander	SPAIN	State Street Corp	USA
Nordea Bank	SWEDEN		
UBS	SWITZERLAND		
Credit Suisse Group	SWITZERLAND		
HSBC Holdings	UK		
Royal Bank of Scotland Group	UK		
Barclays	UK		
Lloyds Banking Group	UK		
European SIBs		**Asian G-SIBs**	
BBVA	SPAIN	Bank of China	CHINA
Intesa San Paolo	ITALY	Sumitomo Mitsui Financial	JAPAN
Swedbank	SWEDEN	Group*	JAPAN
Erste Group Bank	AUSTRIA	Mizuho Financial Group*	JAPAN
Bank of Ireland	IRELAND	Mitsubishi UFJ Financial Group*	

*The three Japanese banks are represented by an asset-weighted average of equity returns.

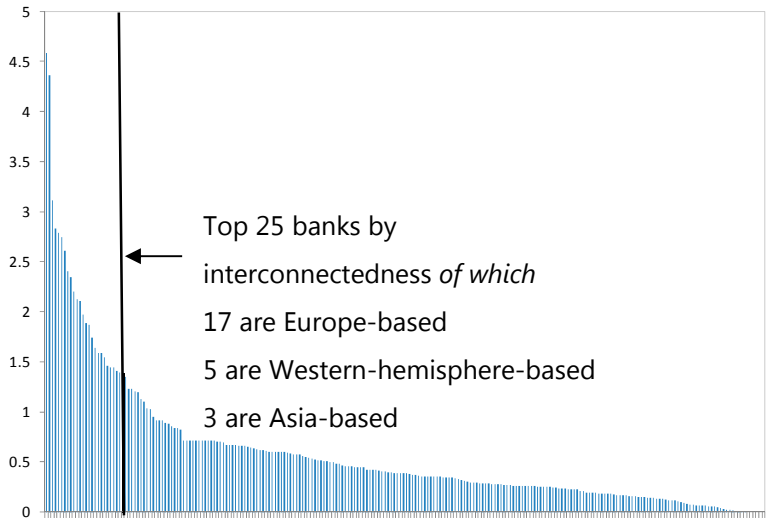
[1] This list does not include two of the European G-SIBs—BPCE and Dexia due to data limitations.

Methodology

2. To identify the SIBs with high capacity to generate spillovers or high susceptibility to spillovers, four approaches based either on bank balance-sheet data or market data are used.

3. ***Balance-sheet based measure of interconnectedness (BSI)*** is computed as an equally-weighted average of three indicators: (i) value of securities holdings of a bank (as a percent of securities holdings of all sample banks), (ii) wholesale funding liabilities of a bank (as a percent of total wholesale funding liabilities of all sample banks); and (iii) wholesale funding ratio of a bank (in percent, normalized by the average wholesale funding ratio of a sample bank). The sample includes around 260 banks domiciled in 25 jurisdictions with systemically important financial sectors. This approach follows closely (using publicly available data) the G-SIB identification methodology of the Basel Committee on Banking Supervision.

Appendix Figure 1 BSI indicators for the sample of 260 banks domiciled in 25 jurisdictions with systemically important financial sectors



4. **Diebold-Yilmaz measure (DY)**. *The spillover measure suggested by Diebold and Yilmaz (2009) is a time-varying indicator of outward-spillovers of institutions—the contribution of one institution to systemic risk. In this note, the indicator uses market data on daily equity returns of the SIBs, and estimates contribution of a SIB in total outward spillovers to other institutions. Vector Autoregressions (VAR) of the weekly returns of 30 institutions are used to derive DY. Specifically, the variance decomposition (VD) at the 10th lag is used to derive a matrix of the portion of variance of the shocks to one institution attributable to another institution. The DY measure of spillover contributions of institution i is the percentage of institution i in the total VD of all institutions' outward spillovers. The measure is based on central moments.*

5. **Conditional Value-at-Risk (CoVaR),** *Adrian and Brunnermeier (2010), uses market data to assess the contribution of an individual financial institution to systemic risk.—specifically, ΔCoVaR, the difference between the VaR of the financial system conditional on the distress of a particular financial institution i and the VaR of the financial system conditional on the median state of the institution i. Estimation is via Quantile regressions—the 5th and the 50th—of the daily returns in the asset-weighted daily equity returns, X^{system}_t, of the system—including all the SIBs in the sample—are run on each institution's daily equity returns, X^i_t.*

$$X_t^{system} = \alpha^{system|i} + \beta^{system|i} X_t^i + \varepsilon_t^{system|i}$$

The predicted/fitted values are used to derive the following at q=5% and q=50%:

$$CoVaR_t^i(q) \equiv \hat{X}_t^{system} = \hat{\alpha}^{system|i} + \hat{\beta}^{system|i} VaR_t^i(q)$$

Finally, the ΔCoVaR of each institution is simply:

$$\Delta CoVaR_t^i(5\%) = CoVaR_t^i(5\%) - CoVaR_t^i(50\%)$$

Each marker in the 'COVAR' panel denotes the $\Delta CoVaR_t^i(5\%)$ for each institution. It is the system-wide loss (in terms of percentage point of system returns) due to one institution moving from its median state to a (tail) risky state.

6. **Chan-Lau-Mitra-Ong (CMO)**. *The CMO (2012) spillover measure is an indicator of outward-spillovers of institutions during extreme times—the potential contribution of one institution to systemic risk during crisis. The indicator uses market data on returns (here, based on daily equity returns) to estimate extreme contributions to spillovers. All extreme events in the data—comprising daily returns on equities—are indentified at the 5th percentile of the joint distribution of returns. All returns lying in the left-tail, that is, the ones below the 5th percentile thresholds, are called 'exceedances'. Then distress-dependence is estimated by using a logit model with the probability of a SIB being in exceedance estimated conditional on exceedances in other financial institutions.*

7. **The SIBs are identified as having a high capacity to generate spillovers or high susceptibility to spillovers based on the following criteria**:

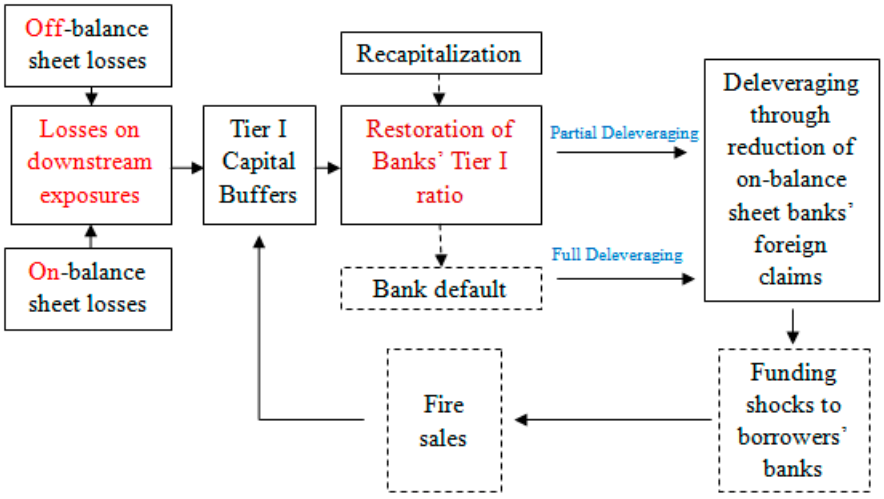
- "High capacity to generate spillovers" are above-median on the balance-sheet based interconnectedness indicator (BSI) and at least two out of the three market-based spillover indicators (CoVaR, CMO and DY).

- "High susceptibility to spillovers" are above-median on spillover-susceptibility from European SIBs listed under "High capacity to generate spillovers" on both DY and CMO indicators.

Appendix II: Scenario Analysis Methodology

1. The scenario analysis includes several rounds of asset and funding shocks, see Figure II-1. The first round considers bank losses on assets that deplete their capital partially or fully. The banking sector losses are calculated based on percentage loss assumptions in a particular economic sector (public sector, banking sector, and/or nonbank private sector) of an individual country or group of countries. Losses can also be assumed in the off-balance sheet exposures to an individual country or group of countries.[1] In the second round, if losses are large enough, a capital ratio (e.g. Basel III Tier I capital asset ratio) is assumed to be restored through deleveraging (loans not being rolled over and selling of assets, assuming no recapitalization). In the third round, banks are assumed to reduce their lending to other banks (funding shocks), causing fire sales, and further deleveraging. Potential bank failures cause additional losses to other banks on the asset and liability sides. Final convergence is achieved when no further deleveraging needs to occur. The possibility of recapitalization allows the simulation of how a policy reaction could mitigate the deleveraging process. Further methodological details involved in the propagation of a default episode through triggering bank losses and deleveraging are presented below (see Tressel, 2010, and Cerutti et al 2011).

Appendix Figure II-1: Shock Propagation across Borders through Bank Losses and Deleveraging

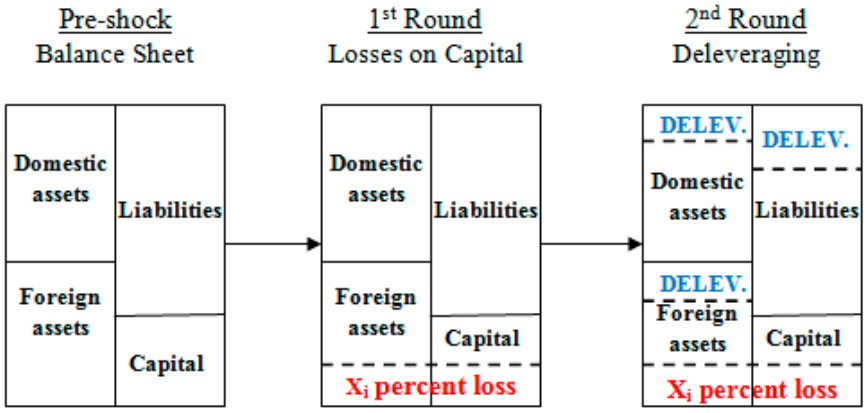


2. In this context, contagion across borders and through common lender effects can now be analyzed. Consider a common shock, due to a crisis in a particular sector/s in one or more countries, that involves losses of X_i percent on the foreign assets of banks from country *i* (illustrated in Figure II.2). If capital buffers are not large enough, and/or without bank recapitalization, deleveraging will

[1] In the case that default losses in particular sector/s of a BIS reporting country are assumed, the calculated losses for that BIS country will also include domestic banking sector exposures to that sector/s.

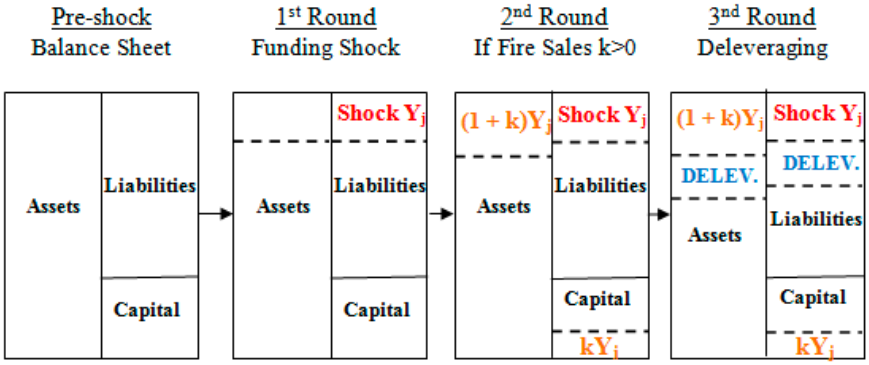
need to occur to restore the assumed Tier I capital ratio of 10 percent.[2] As depicted in Figure II.2, the analysis assumes for simplicity that deleveraging occurs proportionally across domestic and foreign assets.

Appendix Figure II.2: Effect of Foreign Credit Losses on the Balance Sheet of Country *i* Banks



3. The process of deleveraging then means a global reduction in claims of all banks affected, either directly or indirectly, impacting financing and economic activity in various countries. For banks in borrower country *j*, the funding shock (Y_j) equals the deleveraging across all its creditor countries (Figure II.3). If the funding shocks trigger fire sales, banks could experience further losses, triggering additional deleveraging if capital buffers are not large enough and/or in the absence of bank recapitalization. The system converges to a steady state when no further deleveraging takes place (i.e. banks meet their capital adequacy requirements).

Appendix Figure II.3: Effect of a Funding Shock on Balance Sheet of Borrower country *j* Banks



[2] In Europe, following EBA, the Tier I capital to assets ratio is set to 10% (EBA target is 9 percent of core Tier I capital, but this measure is not available for the analyzed banking sectors). and following Basel III, the Tier I capital to assets ratio is set to 6%. For other countries (e.g. Basel III is also set as percentage of core Tier I capital, 4.5%, so this is also an approximation).

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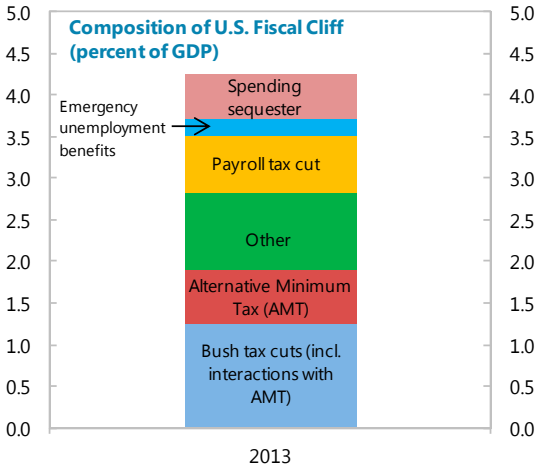
III. UNITED STATES

8. Global Implications of the US Fiscal Cliff [1]

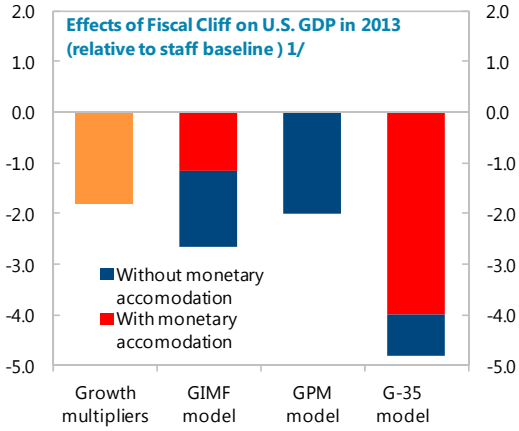
The US budgetary outlook for next year is highly uncertain given the unusual confluence of expiring tax provisions and automatic spending cuts. In the absence of political agreement, fiscal policy would dramatically tighten, with severe economic consequences at home and negative spillovers to the rest of the world. Policymakers should resolve these uncertainties as soon as possible.

1. **US fiscal policy next year is subject to considerable uncertainty**. While most policymakers agree that the budget deficit should not be reduced too rapidly given the weak economy, a bipartisan agreement on policies is unlikely until after the November elections—shortly before numerous tax provisions (including the Bush tax cuts) are scheduled to sunset and deep automatic spending cuts take effect. Since the political debate on tax and spending policies is highly polarized, Congressional gridlock could result in a sudden fiscal contraction ("fiscal cliff") of more than 4 percent of GDP in structural primary terms in 2013—about 3 percent of GDP above the staff baseline. It needs to be stressed, however, that the cliff remains mostly a tail-risk scenario; Congress resolved similar high-stakes situations in the past.



Sources: CBO; and IMF staff estimates.

2. **Should the tail risk of fiscal cliff materialize, the US economy could fall into a fully-fledged recession**. Some anticipatory effects would be felt already in late 2012—subtracting perhaps ½ percent from H2/2012 annualized growth according to the Congressional Budget Office (CBO), especially if consumers and businesses start perceiving the risk of an abrupt fiscal withdrawal as nonnegligible and hold back their spending plans. The economic effects of the cliff during 2013 are not possible to pin down precisely,



Sources: GIMF, GPM, and G-35 model simulations.
1/ Technical details of simulations differ significantly across models; see the main text for explanations.

[1] Prepared by Martin Sommer (WHD), Ben Hunt, Keiko Honjo, Jean-Marc Natal, Mousa Shamouilian, and Stephen Snudden (all RES), and Francis Vitek (SPR).

not least because the sudden fiscal withdrawal would be unusually large and much would depend on whether policymakers subsequently agree on reversing part of the cliff. IMF calculations suggest, however, that if the sharp fiscal contraction is maintained throughout 2013, GDP growth would be around zero at best:

- Applying standard growth multipliers to individual components of the fiscal cliff yields a growth forecast of about ½ percent of GDP next year—that is 1¾ percentage points of GDP below the staff baseline growth forecast is 2¼ percent.[2]

- GIMF and GPM models which explicitly take into account the zero bound on monetary policy point to stronger negative effects, with 2013 growth predicted between +¼ and –½ percent (that is, 2–2¾ percentage points of GDP below the staff baseline).[3]

- The G-35 model which takes different technical assumptions about the cliff while assuming additional negative financial market confidence effects suggests that US annual growth could fall to as little as -2½ percent.[4] Confidence could be eroded, for example, by brinkmanship over the federal debt ceiling which needs to be raised early next year.

- In sum, the short-term economic effects of the fiscal cliff would be severe. Higher unemployment would increase the probability of unfavorable medium-term hysteresis effects as the unemployed stay out of work for longer, lose skills, and are discouraged from looking for a job. Even if the fiscal cliff were quickly unwound, the damage to the economy could be substantial, especially if consumers and businesses were faced with continued uncertainty about future tax and spending policies.

While the spillovers to the rest of the world would mostly propagate through trade channels, the negative effects would be felt strongly in many countries given the magnitude of the US fiscal contraction. The spillovers would be strongest among immediate neighbors (Canada and Mexico), with the first-year growth impact of roughly ½ of the US effects, that is, 1–1½ percentage point of GDP in the scenario with stagnating—but not recessionary—US economy. For advanced Europe and Japan, the growth impacts would be much smaller, typically at less than ⅕ of the US growth shock, but a reduction in growth by ¼–½ percentage points would still be

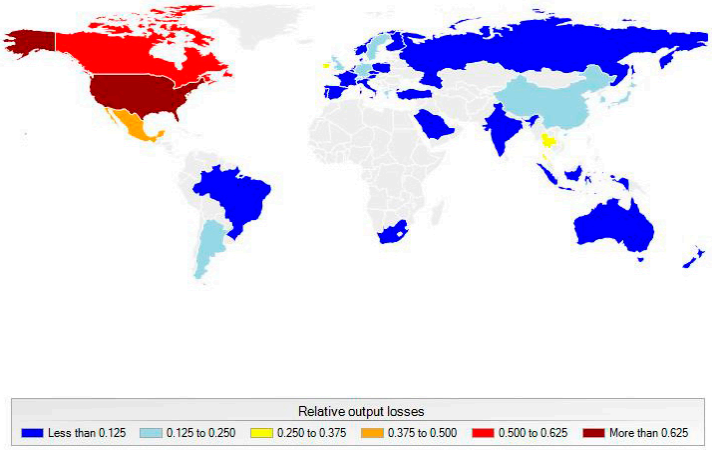
[2] The multiplier assumptions take into account the current weak economic conditions with output below potential, but do not fully incorporate the zero interest rate bound on monetary policy.

[3] The GIMF model provides a full general equilibrium assessment of the fiscal cliff under the zero interest rate floor on nominal interest rates under the assumptions that the fiscal cliff is permanent and private sector decisions are affected by the future reduction in interest rates due to a more favorable public debt profile. The GPM simulations are simpler—they start from the preliminary estimate of output losses on the basis of fiscal multipliers, and adjust it to account for the fact that monetary policy is constrained by the zero interest rate floor.

[4] The G-35 model treats the fiscal cliff as temporary but persistent and effectively constrains the degree to which the reduction of public debt caused by the fiscal cliff influences spending decisions by the private sector.

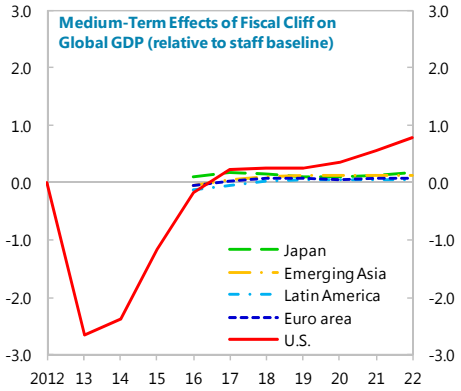
punishing, given the very weak cyclical position and narrow policy space. The spillovers could be amplified through negative confidence effects, for example reflected by a globally-synchronized drop in stock prices. The spillovers to emerging markets would be more manageable given moderate elasticities (also less than 1/5 of the US GDP effect), but higher trend growth rates, and generally more policy flexibility. That said, the model simulations may not fully capture the adverse effects of falling US demand on commodity prices and export-related investments when the underlying US shock is large.

Spillovers from the US Fiscal Cliff in 2013



Note: The map displays a ratio of domestic and US output effects.
Source: G-35 model simulations.

3. **Over the medium term, the debt reduction resulting from the fiscal cliff would likely offset the negative short-term output effects**. After 10 years, the US federal debt ratio would fall by over 20 percentage points of GDP below the staff's baseline scenario. The attendant drop in the world interest rate and a reduction in US risk premia[5] would offset the negative structural effects of higher labor and capital taxation, boosting US output above the WEO baseline. Output would be only slightly higher in the rest of the world. However, model simulations suggest that the negative unemployment hysteresis effects noted above would erode some of the positive effects from lower public debt, underscoring the staff's view that fiscal consolidation is best achieved through a gradual deficit reduction within a medium-term framework.



Sources: GIMF model simulations.

[5] At present, there is no evidence of risk premia in the Treasury yields. Given the high and rising US public debt levels, however, modest risk premia are built into the long-term term staff forecast.

9. Effects of a Sovereign Debt Crisis in the United States[1]

The global macroeconomic costs of a hypothetical sovereign debt crisis in the US, triggered by acute concern over US fiscal sustainability, are analyzed using the G35 Model. Severe output losses in the US are accompanied by moderate to very severe output losses in the rest of the world. These spillovers are concentrated among geographically close trading partners and emerging economies with open capital accounts.

Introduction

1. **This note analyzes the global macroeconomic costs of a hypothetical sovereign debt crisis in the US** triggered in the future by acute concern over fiscal sustainability there, with and without accounting for monetary and fiscal policy responses in the rest of world. This analysis is based on a scenario simulated with the structural macroeconometric model of the world economy, disaggregated into thirty five national economies, documented in Vitek (2012). Within this framework, each economy is represented by interconnected real, external, monetary, fiscal, and financial sectors. Spillovers are transmitted across economies via trade, financial, and commodity price linkages.

Scenario Specification

2. **We simulate a scenario representing a potential future sovereign debt crisis in the US.** To measure spillover mitigation by conventional monetary policy responses and automatic fiscal stabilizers in the rest of the world, we simulate subscenarios which account for and abstract from these mechanisms. We assume that all of the shocks driving this scenario are temporary but persistent, following first order autoregressive processes having coefficients of 0.975.

3. **Our sovereign debt crisis scenario represents a destabilizing spiral of intensifying financial stress** and deteriorating confidence in the US which triggers a procyclical fiscal consolidation reaction there. We represent acute stress in the money, bond and stock markets with a positive credit risk premium shock which raises the short-term nominal market interest rate by 133 basis points, a positive duration risk premium shock which raises the long-term nominal market interest rate by 200 basis points, and a positive equity risk premium shock which reduces the price of equity by 27 percent. These risk premium shocks are correlated internationally to account for contagion effects. We represent confidence losses by households and firms with a negative private domestic demand shock which gradually reduces domestic demand by 1.3 percent. We assume a fiscal consolidation reaction by the government which gradually raises the ratio of the fiscal balance to nominal output by 1.3 percentage points. Expenditure measures represented by a negative fiscal expenditure shock account for 75 percent of this fiscal consolidation, while revenue measures represented by a positive fiscal revenue shock account for the remainder. Finally, there is a run on

[1] Prepared by Francis Vitek (SPR).

the currency, represented by an exchange rate risk premium shock which depreciates it by 13.3 percent in nominal effective terms.

Simulation Results

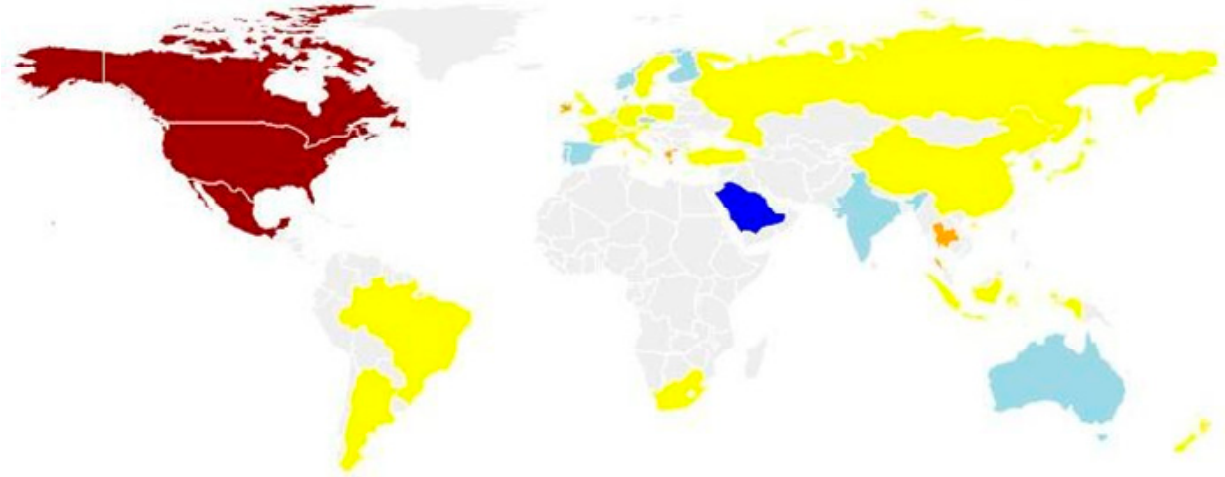
4. **Under this scenario, severe output losses in the US are accompanied by moderate to severe output losses in the rest of the world.** These spillovers are concentrated among geographically close trading partners and emerging economies with open capital accounts. Simulated peak output losses in the US range from 5.2 to 5.7 percent, depending on the degree to which monetary and fiscal policies respond in the rest of the world. Accounting for conventional monetary policy responses and automatic fiscal stabilizers in the rest of the world, simulated peak output losses range from 1.7 to 6.6 percent in other advanced economies, and from 0.5 to 6.3 percent in emerging economies. Abstracting from nominal policy interest rate cuts with offsetting positive monetary policy shocks and automatic deteriorations in the ratio of the fiscal balance to nominal output with offsetting negative fiscal expenditure shocks in the rest of the world amplifies these spillovers considerably. Indeed, under this subscenario simulated peak output losses range from 3.9 to 10.9 percent in other advanced economies, and from 3.1 to 11.3 percent in emerging economies. Aggregating these results implies a simulated peak world output loss of 3.4 to 6.0 percent, depending on the degree to which monetary and fiscal policies respond.

References

Vitek, F., 2012, "Policy Analysis and Forecasting in the World Economy: A Panel Unobserved Components Approach," IMF Working Paper 12/149, (Washington: International Monetary Fund).

Figure 1 Simulated Peak Output Losses

With Monetary Policy Responses, With Automatic Fiscal Stabilizers



Without Monetary Policy Responses, Without Automatic Fiscal Stabilizers

Note: Depicts simulated peak output losses less than 1.0 percent ■, between 1.0 and 2.5 percent ■, between 2.5 and 4.0 percent ■, between 4.0 and 5.5 percent ■, between 5.5 and 7.0 percent ■, and greater than 7.0 percent ■

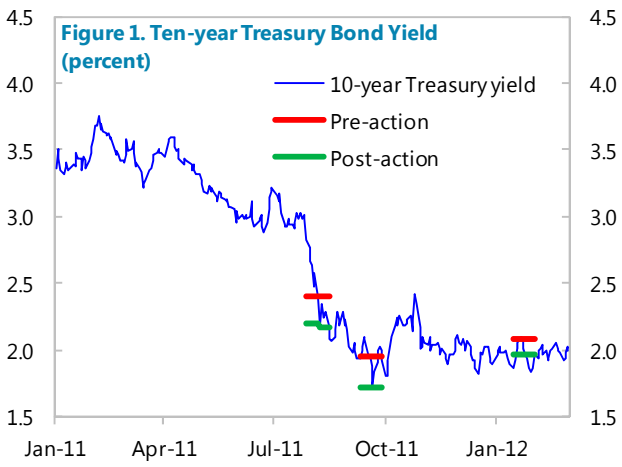
10. Recent US Monetary Policy Actions—Domestic and International Effects [1]

The Fed adopted several unconventional monetary policy actions over the past year to ease financial conditions and support the economic recovery. Event studies show evidence of international spillovers leading to downward pressures in yields of foreign government securities and some impact on exchange rates (depreciation of US NEER). However, in some cases the pass through from the Fed actions was more than offset by a deteriorating global outlook and risk sentiment.

Introduction

1. **The Fed responded to weaker-than-expected US growth over the past year with a number of easing actions**. The FOMC started to provide more explicit guidance on the path of the federal funds rate; announcing in August 2011 that it anticipated economic conditions to warrant exceptionally low federal funds rates at least through mid-2013. In January 2012, it extended its "conditional commitment" to late-2014. In September 2011, to support conditions in mortgage markets, the Fed started reinvesting principal payments on agency debt and agency MBS into agency MBS. In addition, it launched "Operation Twist" (OT), entailing purchases of up to $400 billion in US Treasury securities with remaining maturities of 6–30 years and sales of an equal amount of securities with remaining maturities of 3 years or less, to be completed by June 2012. The FOMC (in June 2012) decided to extend OT through the end of 2012, involving an additional purchases of $267 billion in Treasuries with remaining maturities of 6 or more years (this latest extension is not examined in the note). As with the Fed's prior large scale asset purchases (LSAPs), the goal of OT was to reduce long-term interest rates in order to stimulate economic activity.

2. **The international effects of the Fed's recent policy actions are analyzed using event studies**. The Fed actions are likely to affect not only domestic yields and assets prices, but also have an impact on foreign yields and asset prices, as well as exchange rates. The event studies—subject to a high degree of uncertainty given the unusually volatile market conditions in August-September—suggest that the Fed actions were associated with a reduction in ten-year US Treasury yields by around 50 basis points (cumulative effect). The international effects were mixed. Forward guidance announcements were followed by a depreciation of the dollar and falling interest rates on government bonds, but



Source: Haver Analytics.

[1] Paulo Medas and Geoffrey Keim (WHD).

OT was accompanied by a flight from most emerging markets and an appreciation of the dollar.

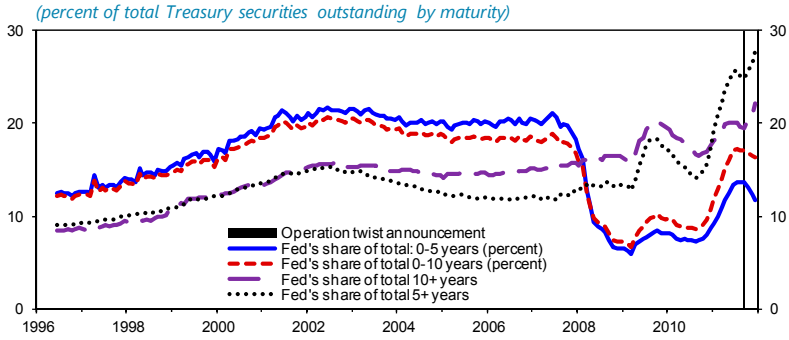
3. **The note is organized as follows**. Section II briefly discusses the mechanisms through which the Fed's recent actions may have affected domestic and international financial conditions. Sections III focuses on the international effects following the Fed's easing actions since mid-2011, but also provides a quick overview of the domestic impact as a background. Section IV concludes.

Mechanisms

4. **In principle, larger securities holdings by the Fed raise the prices of those securities and substitute assets**. Empirical evidence for prior LSAPs suggests that a reduced supply of Treasury securities to the public lowers the yields of the purchased securities as well as yields on securities with similar maturities. However, substitutability and the impact on yields diminish as maturities and risk structure get farther apart (D'Amico and King, 2011; Gagnon et al., 2010).[2]

Figure 2. Federal Reserve Ownership of Treasury Securities Outstanding, by Maturity

(percent of total Treasury securities outstanding by maturity)



Sources: Board of Governors of the Federal Reserve System; U.S. Department of the Treasury; Haver Analytics; and Fund staff estimates.

5. **By contrast, forward-guidance on the path of the policy rate lowers rates across the yield curve to the extent that it signals an easier-than-anticipated monetary policy stance**. The signal could be particularly clear—and strong—under the zero lower bound on policy rates, and all interest rates are likely to be affected. Some analysts have argued that one channel through which LSAPs ease financial conditions is by signaling a commitment to keep rates low; however, others argue the evidence does not support that this channel is effective (Krishnamurthy and Vissing-Jorgensen, 2011).[3]

6. **The actions of the Fed could also impact exchange rates and foreign asset prices**. Yields on foreign securities are likely to be affected to the extent that investors change their portfolio composition between US versus non-U.S. securities in response to changes in the yields of US securities. Yields on foreign bonds are likely to fall less than yields on US securities, given their imperfect substitutability. The decrease in the differential between US and foreign yields

[2] These effects are in line with the preferred habitat and portfolio-balance theories.

[3] Similarly, Farmer (2012) argues that purchases of assets other than Treasuries (say MBS), can be an useful tool to signal the future path of the Fed's policies when interest rates hit the zero lower bound, and drive market expectations.

would, in turn, be consistent with an expected appreciation of the US dollar (assuming no change in its expected long-run level) and therefore, an immediate US dollar depreciation. Neely (2011) reports significant effects of the Fed's 2008–09 LSAP on foreign long-term bond yields and the US dollar exchange rate.

Financial Spillovers to Selected Advanced and Emerging Market Economies

7. **This section assesses the spillovers on international financial markets from the Fed's actions over the last year**. The analysis is based on event studies measuring the (one-to three-day) responses of long-term government bonds, stock market indices and exchange rate rates (bilateral rates versus the US dollar) for a sample of advanced economies (AE) and emerging markets (EM).[4] As discussed above, the easing actions of the Fed would be expected to reduce the yields of government bonds in the US and other countries, assuming foreign bonds are seen as partial substitutes to Treasuries. Yields on government bonds do tend to be correlated, especially among advanced economies (Figure 3). The announcements would also be expected to lead to a depreciation of the US dollar.[5]

Operation Twist

8. **Operation Twist was launched on September 21, 2011, following a period of worsening US economic data**. OT was aimed at lowering longer-term yields by expanding the share of the outstanding securities held by the Fed. The event studies show the 10-year Treasury yield fell by 22 basis points in the two-days following the announcement (Table 1), while the 30-year Treasury rate fell by 41 basis points and yields on 30-year agency MBS fell 28 basis points. All three changes were significant.[6] However, the prices of riskier assets declined sharply. The stock market and oil prices fell by a large 6–7½ percent; uncertainty, as measured by the VIX, also rose significantly, and the US dollar appreciated. This negative reaction was likely due to adverse economic news, including the downgrade by Moody's of three large US banks on the same day, and a deteriorating economic outlook.

[4] Advanced economies: France, Germany, Italy, United Kingdom, and Japan. Emerging markets: Brazil, China, Korea, Mexico, South Africa, and Turkey. This section follows a methodology similar to Neely (2011), where the focus was on LSAPs and advanced economies only.

[5] This note does not look at all potential spillovers from the Fed actions. For example, if the Fed actions lead to higher growth in the US that would have a positive effect on other countries.

[6] The table shows in italic the fraction of two-day periods in the sample in which the yield changes for each variable fall below the observed reaction to the announcement ("p-value").

Table 1. Effects of Operation Twist and Forward Guidance Announcements

(two-day changes; yields in percentage points, stocks and exchange rates in percent)

	10-Year Government Bond Yield	30-Year Government Bond Yield	30-Year MBS	Stock Market (S&P)	Investment Grade Bond Yield	VIX 1/	WTI Oil Price	Exchange Rate
Operation Twist								
9/21/2011	-0.221	-0.406	-0.284	-6.034	0.017	8.49	-7.63	2.247
	0.011 ^^	*0.001* ^^^	*0.013* ^^	*0.009* ^^^	*0.627*	*0.986* **	*0.022* ^^	*0.999* ***
Forward Guidance								
8/9/2011	-0.212	-0.139	-0.338	0.116	-0.042	-5.01	2.19	0.172
	0.014 ^^	*0.045* ^^	*0.008* ^^^	*0.503*	*0.282*	*0.025* ^^	*0.763*	*0.679*
1/25/2012	-0.129	-0.059	-0.147	0.288	-0.142	-0.340	0.931	-0.802
	0.066 ^	*0.222*	*0.067* ^^	*0.551*	*0.030* ^^	*0.422*	*0.602*	*0.043* ^^

Notes: The numbers in italics are the fraction of daily two-day changes that fall below two-day change around the announcement date over the period from December 30, 2005 to April 11, 2012. *, **, *** denote observations in the 90th, 95th, and 99th percentiles, respectively. ^, ^^, ^^^ denote observations in the 10th, 5th, and 1st percentiles, respectively.

1/ Absolute changes for the VIX .

Sources: Fund staff calculations on data from Bloomberg, LP and Haver Analytics.

9. **The announcement of OT came on a day with elevated turbulence in global financial markets and rising concerns with the global economic outlook**. It thus coincided with a flight from EMs (and mixed changes in AEs):

- Government yields fell among AEs (between 3–17 basis points), although somewhat less than US Treasury yields, as expected. However, the bilateral exchange rate versus the US dollar depreciated in advanced economies (except Japan) likely reflecting a flight to safety to a reserve currency.

- Among most EMs, the immediate impact was in the opposite direction relative to what would have been predicted based on the portfolio-balance channel. A rise in risk aversion and "flight to safety" among investors seemed to be the dominant factors—with the OT announcement only dampening the effects of rising uncertainty. Some EM currencies experienced large depreciation pressures (e.g., Brazil, Mexico, and South Africa) and the yields for government bonds rose between 10–30 basis points (Brazil, Mexico, South Africa, and Turkey). On the other hand, Korea and China saw their government yields fall. Stock markets, as other risky asset prices, fell sharply in the days following the announcement (especially in Brazil, Mexico, and Korea).

Forward Guidance

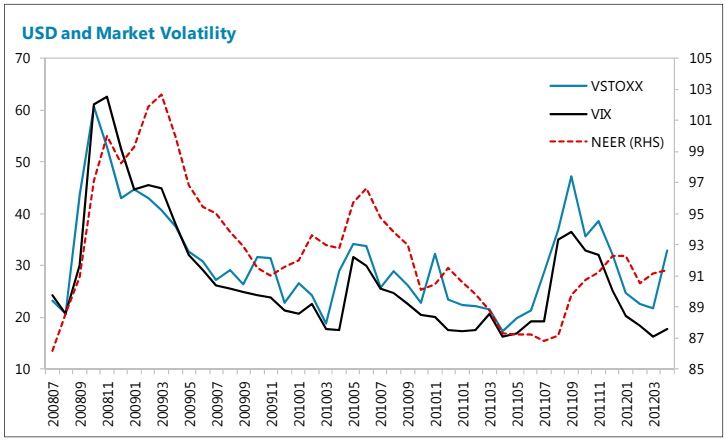
10. **The Fed lowered long-term interest rates by providing explicit forward guidance on the policy rate path**. Event studies indicate that both the August 2011 and the January 2012 announcements significantly lowered long-term Treasury yields and MBS yields (Table 1). There was no significant favorable reaction in riskier assets on the August announcement, potentially

due to the financial volatility around that time.[7] The January 25 announcement was, however, met by some decline in the investment-grade bond yield.

11. **The August statement was followed by a generalized fall in yields and depreciation of the US dollar**. Government yields tended to fall across all countries over the 2-day window (by 5–17 basis points), in some cases the drops were quantitatively significant and similar to the fall in the yields on US Treasury securities (21 basis points for the ten-year Treasury bond). The US dollar depreciated significantly against most currencies on the day of the announcement, but the impact tended to become less pronounced or disappear over the following days (with the exception of China). The behavior of the stock market varied widely across countries, with markets falling significantly in Europe (reflecting elevated market stress in the Euro area that week) and posting large gains in other countries (U.S., Brazil, Canada, and Mexico).

12. **The January FOMC statement had a less pronounced impact on government yields, but the effects on the exchange rate were more persistent than after the August statement**. Longer-term bond yields fell significantly in several AEs and EMs (especially in South Africa, European countries, and Mexico). Bilateral exchange rates appreciated for most advanced economies vis-à-vis the US dollar, especially the Euro, and in EMs (with Mexico, South Africa, and Turkey appreciating the most, between 1–2 percent) with the effects tending to be more persistent than after the August statement. Stock markets reacted positively, but the impact was not large, with a few exceptions.

13. **The evidence suggests the Fed's actions played a limited role in explaining the movements (and volatility) in long-term yields and exchange rates over the past years**. All the Fed actions (OT and the two forward guidance announcements) lowered US Treasury yields; but at most they explain about one-third of the decline in the ten-year yield over the last 12 months.[8] Given the difficulty in assessing the impact of the Fed's actions (in particular OT) on exchange rates using event studies alone, staff also used VARs to estimate the impulse response of the trade-weighted US dollar exchange rate (NEER) to the ten-year US Treasury yield and financial market volatility measures (VIX for the



[7] The announcement was in the middle of a week in which markets were adjusting to the downgrade of US sovereign debt the previous Friday. European debt markets had experienced severe volatility earlier in the same week; and VIX was retracing some of its earlier increase by mid week.

[8] As discussed above, the OT and forward guidance are estimated to have reduced the ten-year Treasury bond yield by about 50 basis points in total (from a wide range of estimates using event studies and regressions).

US and VSTOXX for Europe). The estimated VAR suggests that the impact of the Fed's actions over the last 12 months on the Treasury ten-year yield depreciated the US dollar NEER by ¾ percent. At the same time, the US dollar appreciated by 4½ percent in the period, implying that the effect of Fed's easing actions over the past year on the US dollar NEER were more than compensated by other factors. In particular, the large movements in the US dollar NEER in recent years appear to be mainly associated with the large swings in volatility in global markets: the estimated structural shocks to the VIX account for about a third of the variance of NEER fluctuations between 2008 and April 2012, while the movements in the ten-year Treasury yield accounts for less than ten percent.[9]

Conclusions

14. **The Fed's actions over the past year led to a fall in government yields in other countries and, in some cases, were accompanied by a depreciation of the US dollar.** All the actions lowered US Treasury yields, with some evidence of downward pressure on other yields, especially after statements forward guidance. The international effects were mixed, partly as a result of the unsettled economic conditions—in some cases, the pass through from the Fed actions was more than offset by a deteriorating global outlook and risk sentiment.

- The forward guidance statements led to material drops in government bond yields across AEs and EMs; OT had a similar impact on government bonds for AEs and the Asian EMs. However, OT, which coincided with heightened global risk aversion associated with financial strains in the Euro area, was followed by higher bond yields in the non-Asian EMs and a widespread fall in equity prices.

- The forward guidance statements had a significant, but generally short-lived, impact on bilateral exchange rates. OT, on the other hand, was accompanied by a sharp appreciation of the US dollar as "flight to safety" by investors more than compensated for any depreciation effect from the Fed actions.

- The volatile economic and financial environment at the time of the announcements makes it difficult to discern the effects of the Fed actions even using high frequency event studies. The policy announcements were themselves a reaction to the uncertain outlook and, as such, the observed mixed effects reflect not only investors reaction to the (unanticipated elements) of the policy but also the economic news of the day. In sum, the evidence suggests that recent monetary policy actions contributed to lowering yields on long-term Treasury bonds, but underlying volatile market conditions—reflecting a variety of other shocks—were also a key driver of movements in yields and exchange rates.

[9] In April 2012, the US dollar exchange rate was at a similar level as in August 2008—the depreciation trend of the US dollar since mid-2009 followed a sudden and large appreciation in late 2008–early 2009 when global financial volatility reached historically high levels.

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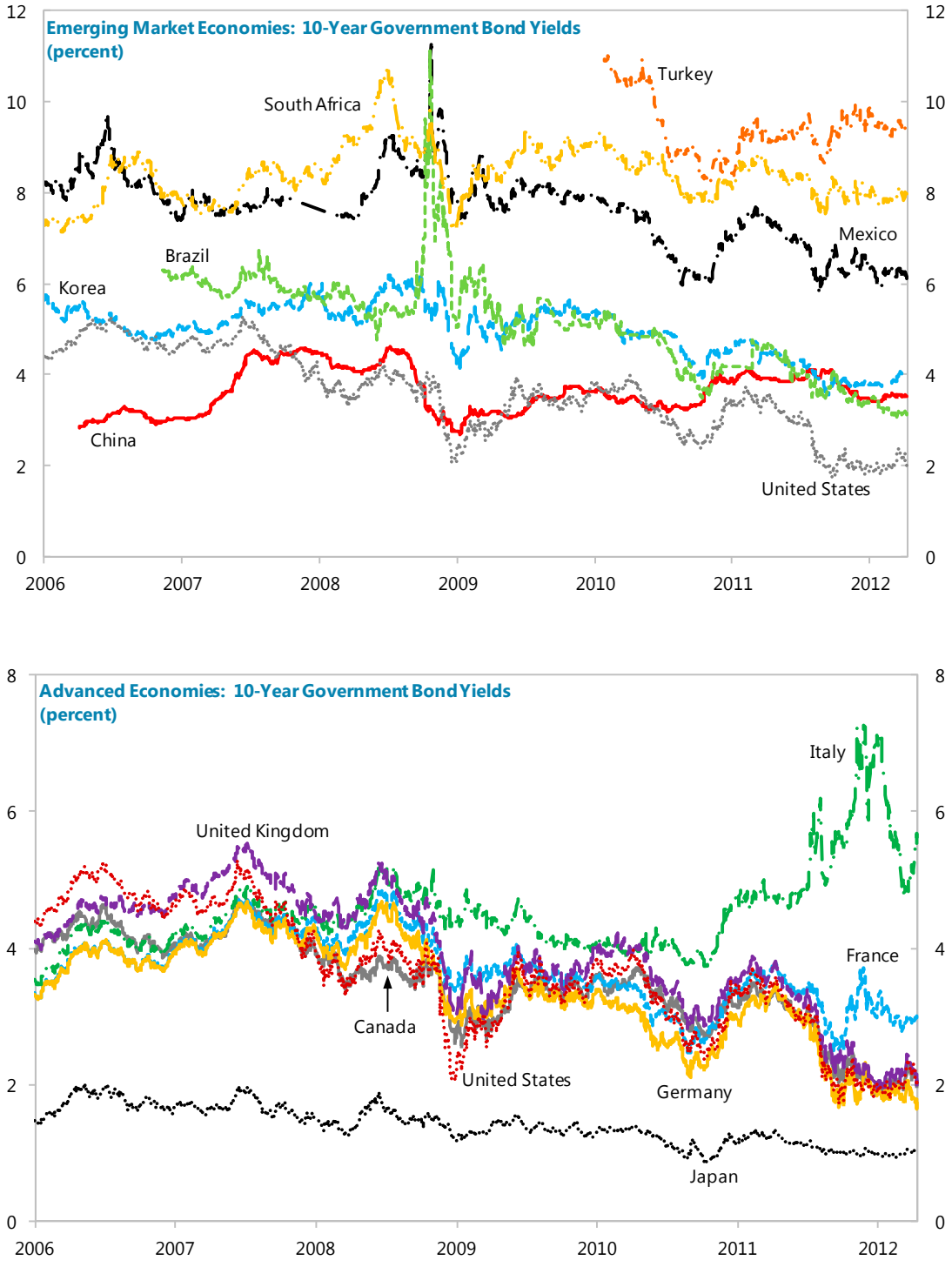
Figure 3. Government Bond Yields



Source: Bloomberg, LP.

Table 2. Financial Market Reaction to the Operation Twist Announcement (September 21, 2011)
(changes from day before announcement)

	One-day changes			Two-day changes			Three-day changes		
	10-year government bond yield	Stock Market	Exchange rate 1/	10-year government bond yield	Stock Market	Exchange rate 1/	10-year government bond yield	Stock Market	Exchange rate 1/
Emerging markets:									
Brazil	0.030	-0.704	5.046	0.291	-5.496	6.721	0.353	-5.584	2.711
	0.778	*0.293*	*0.995* ^^^	*0.973* ^^	*0.027* **	*0.996* ^^^	*0.973* ^^	*0.039* **	*0.941* ^
China 2/	0.000	-2.782	-0.034	-0.010	-3.176	0.060	-0.180	-4.766	0.067
	0.364	*0.069* *	*0.333*	*0.290*	*0.102*	*0.818*	*0.008* ***	*0.078* *	*0.837*
Korea 2/	-0.040	-2.898	0.080	-0.100	-8.458	2.694	-0.020	-10.871	1.602
	0.150	*0.035* **	*0.587*	*0.080* *	*0.003* ***	*0.974* ^^	*0.393*	*0.003* ***	*0.920* ^
Mexico	0.019	-0.928	3.596	0.212	-5.699	6.534	0.225	-5.095	2.495
	0.661	*0.197*	*0.995* ^^^	*0.967* ^^	*0.009* ***	*0.996* ^^^	*0.954* ^^	*0.028* **	*0.965* ^^
Turkey 2/	0.230	-4.682	2.187	0.310	-7.405	3.099	0.330	-6.620	2.797
	0.985 ^^	*0.013* **	*0.974* ^^	*0.981* ^^	*0.010* ***	*0.976* ^^	*0.983* ^^	*0.031* **	*0.949* ^
South Africa 2/	0.140	-3.156	6.656	0.285	-3.992	9.478	0.215	-5.086	4.946
	0.967 ^^	*0.020* **	*0.998* ^^^	*0.988* ^^	*0.036* **	*0.998* ^^^	*0.955* ^^	*0.029* **	*0.984* ^^
Advanced economies:									
Canada	-0.071	-2.087	1.551	-0.173	-5.302	3.596	-0.120	-6.118	3.566
	0.062 *	*0.056* *	*0.973* ^^	*0.009* ***	*0.012* **	*0.994* ^^^	*0.058* *	*0.015* **	*0.991* ^^
France 2/	-0.099	-5.250	0.950	-0.057	-4.282	1.760	-0.021	-2.605	1.496
	0.020 **	*0.008* ***	*0.923* ^	*0.168*	*0.034* **	*0.957* ^^	*0.379*	*0.147*	*0.903* ^
Germany 2/	-0.098	-4.961	0.950	-0.025	-4.366	1.760	0.057	-1.624	1.496
	0.029 **	*0.009* ***	*0.923* ^	*0.344*	*0.033* **	*0.957* ^^	*0.776*	*0.212*	*0.903* ^
Italy 2/	-0.096	-4.520	0.950	-0.129	-3.221	1.760	-0.112	-0.006	1.496
	0.037 **	*0.017* **	*0.923* ^	*0.046* **	*0.086* *	*0.957* ^^	*0.075* *	*0.483*	*0.903* ^
Japan 2/	-0.005	-1.663	0.013	-0.005	n.a.	-0.275	-0.011	-3.735	0.209
	0.399	*0.112*	*0.529*	*0.450*	*n.a.*	*0.356*	*0.401*	*0.063* *	*0.605*
United Kingdom 2/	-0.097	-4.667	1.529	-0.048	-4.190	2.568	0.017	-3.764	1.864
	0.037 **	*0.008* ***	*0.981* ^^	*0.248*	*0.023* **	*0.988* ^^	*0.603*	*0.058* *	*0.951* ^^
Memo: United States	-0.081	-2.939	n.a.	-0.221	-6.034	n.a.	-0.105	-5.462	n.a.
	0.100 *	*0.031* **	*n.a.*	*0.015* **	*0.009* ***	*n.a.*	*0.142*	*0.023* **	*n.a.*

Sources: Bloomberg, LP; Haver Analytics; and Fund staff calculations.

Notes: The numbers in italics are the fraction of changes that fall below the event's change over the period from December 25, 2005 to April 14, 2012. *, **, ** denote observations in the 10th, 5th, and 1st percentiles, respectively; ^, ^^, ^^^ denote observations in the 90th, 95th, and 99th percentiles, respectively.

1/ Exchange rates are expressed as the country's currency per U.S. dollar. A positive change in the exchange rate implies a depreciation of that country's currency.

2/ Shifted ahead one day, to account for time differences.

Table 3. Financial Market Reaction to the August 9, 2011 FOMC Statement
(changes from day before announcement)

	One-day changes			Two-day changes			Three-day changes		
	10-year government bond yield	Stock Market	Exchange rate 1/	10-year government bond yield	Stock Market	Exchange rate 1/	10-year government bond yield	Stock Market	Exchange rate 1/
Emerging markets:									
Brazil	-0.113	5.101	-2.294	-0.084	5.603	-0.080	0.075	9.605	-0.037
	0.066 *	*0.989* ^^	*0.023* **	*0.150*	*0.982* ^^	*0.509*	*0.803*	*0.994* ^^^	*0.543*
China 2/	-0.120	0.915	-0.076	-0.170	2.195	-0.277	-0.150	2.656	-0.654
	0.004 ***	*0.708*	*0.207*	*0.005* ***	*0.821*	*0.050* **	*0.012* **	*0.818*	*0.001* ***
Korea 2/	-0.140	0.271	0.441	-0.160	0.893	-0.279	-0.180	-0.446	-0.137
	0.014 **	*0.556*	*0.804*	*0.020* **	*0.660*	*0.337*	*0.029* **	*0.362*	*0.443*
Mexico	0.042	2.099	-2.321	-0.173	1.588	1.853	-0.180	5.910	-0.409
	0.796	*0.938* ^	*0.006* ***	*0.046* **	*0.812*	*0.959* ^^	*0.071* *	*0.979* ^^	*0.330*
Turkey 2/	-0.106	-5.010	-1.465	-0.083	-1.783	-0.281	-0.067	-1.459	-0.006
	0.083 *	*0.012* **	*0.034* **	*0.233*	*0.207*	*0.415*	*0.309*	*0.261*	*0.524*
South Africa 2/	n.a.	n.a.	-1.186	n.a.	n.a.	0.852	n.a.	n.a.	0.049
	n.a.	n.a.	*0.126*	n.a.	n.a.	*0.732*	n.a.	n.a.	*0.526*
Advanced economies:									
Canada	-0.028	3.755	-1.740	-0.150	4.523	0.040	-0.028	7.444	-1.036
	0.251	*0.990* ^^	*0.012* **	*0.015* **	*0.989* ^^	*0.555*	*0.375*	*0.996* ^^^	*0.156*
France 2/	-0.155	-5.453	-1.370	-0.178	-2.724	0.007	-0.248	1.187	-0.435
	0.002 ***	*0.006* ***	*0.022* **	*0.012* **	*0.098* *	*0.523*	*0.005* ***	*0.696*	*0.351*
Germany 2/	-0.173	-5.132	-1.370	-0.049	-2.018	0.007	-0.032	1.363	-0.435
	0.002 ***	*0.006* ***	*0.022* **	*0.223*	*0.139*	*0.523*	*0.339*	*0.730*	*0.351*
Italy 2/	-0.081	-6.650	-1.370	-0.133	-2.826	0.007	-0.160	1.063	-0.435
	0.051 *	*0.003* ***	*0.022* **	*0.042* **	*0.107*	*0.523*	*0.046* **	*0.693*	*0.351*
Japan 2/	-0.009	0.823	-1.042	-0.010	0.064	-1.170	-0.003	-0.286	-1.196
	0.328	*0.755*	*0.058* *	*0.384*	*0.506*	*0.103*	*0.478*	*0.445*	*0.139*
United Kingdom 2/	-0.231	-3.054	0.012	-0.168	-0.040	1.140	-0.180	3.003	0.486
	0.002 ***	*0.023* **	*0.512*	*0.018* **	*0.462*	*0.907* ^	*0.030* **	*0.929* ^	*0.704*
Memo: United States	-0.069	4.741	n.a.	-0.212	0.116	n.a.	0.022	4.751	n.a.
	0.135	*0.993* ^^^	*n.a.*	*0.017* **	*0.503*	*n.a.*	*0.611*	*0.981* ^^	*n.a.*

Sources: Bloomberg, LP; Haver Analytics; and Fund staff calculations.

Notes: The numbers in italics are the fraction of changes that fall below the event's change over the perod from December 25, 2005 to April 14, 2012. *, **, ** denote observations in the 10th, 5th, and 1st percentiles, respectively; ^, ^^, ^^^ denote observations in the 90th, 95th, and 99th percentiles, respectively.

1/ Exchange rates are expressed as the country's currency per U.S. dollar. A positive change in the exchange rate implies a depreciation of that country's currency.

2/ Shifted ahead one day, to account for time differences.

Table 4. Financial Market Reaction to the January 25, 2012 FOMC Statement
(changes from day before announcement)

	One-day changes			Two-day changes			Three-day changes		
	10-year government bond yield	Stock Market	Exchange rate 1/	10-year government bond yield	Stock Market	Exchange rate 1/	10-year government bond yield	Stock Market	Exchange rate 1/
Emerging markets:									
Brazil	-0.090	n.a.	0.199	-0.070	0.747	-0.535	-0.100	0.669	-1.223
	0.092 *	*n.a.*	*0.640*	*0.185*	*0.597*	*0.335*	*0.157*	*0.559*	*0.197*
China 2/	n.a.	n.a.	-0.131	n.a.	n.a.	-0.054	n.a.	n.a.	-0.084
	n.a.	*n.a.*	*0.103*	*n.a.*	*n.a.*	*0.329*	*n.a.*	*n.a.*	*0.290*
Korea 2/	0.000	0.254	-0.188	-0.020	0.645	-0.554	-0.050	-0.598	-0.432
	0.454	*0.548*	*0.351*	*0.370*	*0.605*	*0.212*	*0.242*	*0.335*	*0.313*
Mexico	-0.064	0.976	-0.617	-0.141	1.051	-0.828	-0.130	0.899	-1.396
	0.123	*0.807*	*0.141*	*0.074* *	*0.719*	*0.138*	*0.134*	*0.639*	*0.076* *
Turkey 2/	-0.170	3.715	-0.775	-0.120	4.439	-1.461	-0.060	5.268	-2.423
	0.033 **	*0.978* ^^	*0.161*	*0.145*	*0.962* ^^	*0.083* *	*0.320*	*0.959* ^^	*0.033* **
South Africa 2/	-0.175	1.273	-0.587	-0.200	0.766	-1.817	-0.170	-0.022	-2.274
	0.008 ***	*0.847*	*0.273*	*0.033* **	*0.648*	*0.096* *	*0.077* *	*0.449*	*0.093* *
Advanced economies:									
Canada	-0.043	1.161	-0.466	-0.072	0.557	-0.714	-0.101	0.575	-0.714
	0.155	*0.873*	*0.220*	*0.129*	*0.629*	*0.197*	*0.093* *	*0.601*	*0.247*
France 2/	-0.051	1.532	-0.534	-0.116	0.190	-0.557	-0.121	-1.414	-1.392
	0.122	*0.879*	*0.188*	*0.043* **	*0.528*	*0.264*	*0.065* *	*0.257*	*0.098* *
Germany 2/	-0.074	1.837	-0.534	-0.087	1.403	-0.557	-0.152	0.352	-1.392
	0.062 *	*0.920* ^	*0.188*	*0.103*	*0.790*	*0.264*	*0.045* **	*0.519*	*0.098* *
Italy 2/	-0.179	1.710	-0.534	-0.333	0.673	-0.557	-0.137	-0.550	-1.392
	0.010 **	*0.903* ^	*0.188*	*0.009* ***	*0.644*	*0.264*	*0.054* *	*0.395*	*0.098* *
Japan 2/	-0.021	-0.364	0.142	-0.036	-0.817	-0.283	-0.043	-1.354	-1.249
	0.171	*0.375*	*0.626*	*0.134*	*0.326*	*0.352*	*0.148*	*0.279*	*0.130*
United Kingdom 2/	-0.069	1.262	-0.204	-0.089	0.183	-0.408	-0.168	-0.907	-0.655
	0.091 *	*0.879*	*0.352*	*0.116*	*0.537*	*0.302*	*0.037* **	*0.291*	*0.254*
Memo: United States	-0.065	0.867	n.a.	-0.129	0.288	n.a.	-0.169	0.128	n.a.
	0.144	*0.813*	*n.a.*	*0.073* *	*0.562*	*n.a.*	*0.057* *	*0.475*	*n.a.*

Sources: Bloomberg; LP; Haver Analytics; and Fund staff calculations.

Notes: The numbers in italics are the fraction of changes that fall below the event's change over the period from December 25, 2005 to April 14, 2012. *, **, ** denote observations in the 10th, 5th, and 1st percentiles, respectively; ^, ^^, ^^^ denote observations in the 90th, 95th, and 99th percentiles, respectively.

1/ Exchange rates are expressed as the country's currency per US dollar. A positive change in the exchange rate implies a depreciation of that country's currency.

2/ Shifted ahead one day, to account for time differences.

11. US Portfolio Flows since the Financial Crisis [1]

Since the onset of the financial crisis in 2008, there is little evidence that US investors have stepped up their purchases of foreign securities in search of higher yields, despite record-low US interest rates. However, the composition of US purchases of foreign securities has changed—for example, while US residents were net sellers of bonds from the euro area and the United Kingdom during 2008–10, they boosted purchases of bonds issued by Australia, Canada, and Latin America. Foreign purchases of US securities have also declined substantially since the crisis, with net sales of US corporate bonds and agency securities more than offsetting an increase in purchases of Treasury securities.[2]

1. **This note examines the pattern of US portfolio investment during the period of very low US interest rates, and contrasts it with the pre-crisis period**. In particular, the note focuses on whether i) US investors have ramped up their purchases of foreign portfolio instruments and ii) whether their portfolio allocation has changed significantly since the crisis. The size of US portfolio outflows is not the only relevant metric in assessing the impact of easy monetary policy in the United States on financial flows—in particular, low US interest rates can alter the investment behavior of third countries, re-directing financial flows that were intended for the United States to other destinations. The analysis is therefore complemented by a brief examination of portfolio flows to the United States.

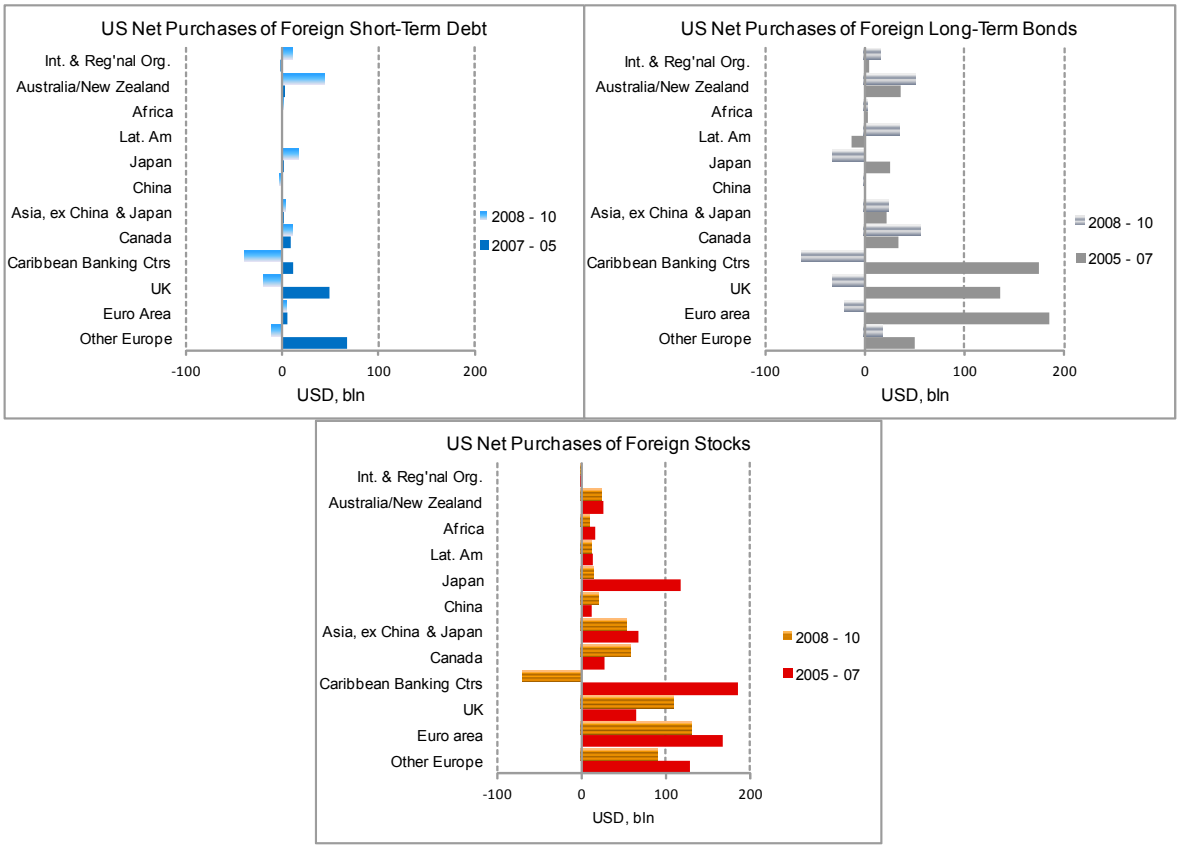
US Portfolio Flows into Foreign Securities

2. **Since the financial crisis, the size and destination of US residents' portfolio flows have changed**. Relative to the pre-crisis period, the size of the portfolio flows fell sharply. During 2005–2007, net purchases of foreign bonds and equities by US residents totaled $675 billion and $470 billion, respectively. In the period since the onset of the crisis, from 2008 to 2010, net purchases of foreign bonds and equities fell to $140 billion and slightly above $100 billion, respectively. The destinations of these portfolio purchases also changed. Pre-crisis, US residents' purchases of foreign securities were mostly directed to the euro area and the United Kingdom. Since the onset of financial crisis, US investors have scaled down dramatically their purchases of long-term bonds and equities from these regions, while they increased purchases of bonds from Australia, Canada, Latin America, and Asia (excluding China and Japan). Portfolio flows in foreign short-term bonds—significantly smaller relative to long-term bonds—largely mirrored those seen in long-term bonds. Meanwhile, foreign stock purchases generally fell.

[1] Prepared by Sally Chen (SPR).

[2] The bulk of the data for portfolio flows is from Treasury's TIC system. In particular, data for 2011 positions are from the newly-released TIC SLT surveys.

Figure 1. U.S. Net Purchases of Foreign Securities



Sources: Treasury TIC, Federal Reserve.
Flows calculations as per Bertaut & Tryon (2007).

3. **The largest holdings of foreign portfolio instruments by US investors are equity holdings in Europe**. With the post-crisis rebound in equity valuations, US residents' positions in foreign portfolio instruments have largely recovered from the declines seen during the financial crisis in 2008.[3] At the end of 2011, portfolio equity holdings in Europe totaled around $2 trillion (Table 1) with sizable holdings in Asia and Caribbean banking centers as well. US holdings of foreign bonds are generally less than half in size relative to equity holdings, with the largest holdings in Europe followed by Canada and Caribbean banking centers. Relative to the pre-crisis period, there are notable increases in bond holdings in Australia, Canada, and Latin America, reflecting the volume of flows highlighted earlier.

[3] Data for US aggregate holdings of foreign securities in 2011 are based on the newly-related TIC SLT (Securities Long Term), which complements the existing annual benchmark surveys of securities holdings. The two surveys are compiled differently—SLT generally has a lower reporting threshold and due to greater outreach effort, has over 300 respondents relative to roughly 100 for the annual survey.

Table 1. End of Year US Residents' Positions in Foreign Securities

End of Year Positions - Short-Term Bonds (US$, bln)

	Euro Area	UK	Other Europe	Caribbean Banking Ctrs	Canada	China	Japan	Asia, ex CHN & JPN	Lat. Am	Africa	Australia/ New Zealand	Int. & Reg'nal Org.	Total Holdings
2005	76	92	35	29	14	0.01	2	1	1	0	11	3	263
2006	96	156	35	40	18	0.10	7	1	0	1	12	3	368
2007	82	141	48	41	22	0.13	4	2	1	1	13	2	357
2008	83	85	39	18	32	0.03	2	1	1	1	14	5	282
2009	95	156	35	8	26	0.02	8	1	0	0	49	8	387
2010	87	123	51	3	34	0.03	22	6	1	4	57	13	402
2011	…	…	…	…	…	…	…	…	…	…	…	…	…

End of Year Positions - Long-Term Bonds (US$, bln)

	Euro Area	UK	Other Europe	Caribbean Banking Ctrs	Canada	China	Japan	Asia, ex CHN & JPN	Lat. Am	Africa	Australia/ New Zealand	Int. & Reg'nal Org.	Total Holdings
2005	228	185	69	137	158	2	35	85	86	6	54	19	1,028
2006	321	245	88	198	162	1	46	104	81	7	66	19	1,294
2007	422	287	105	295	186	1	60	126	77	9	77	22	1,610
2008	325	185	74	227	166	2	54	113	64	6	77	20	1,261
2009	412	240	100	249	220	1	41	115	92	9	113	40	1,594
2010	402	253	126	227	253	2	47	147	116	13	130	41	1,715
2011 Est.	456	290	153	329	335	2	56	166	146	17	161	40	2,095

End of Year Positions - Equities (US$, bln)

	Euro Area	UK	Other Europe	Caribbean Banking Ctrs	Canada	China	Japan	Asia, ex CHN & JPN	Lat. Am	Africa	Australia/ New Zealand	Int. & Reg'nal Org.	Total Holdings
2005	757	538	319	345	248	27	493	850	154	40	76	-	3,318
2006	1,054	674	463	431	298	74	544	1,050	207	49	107	0.3	4,329
2007	1,296	715	559	604	380	96	529	1,194	294	66	142	0.4	5,253
2008	665	377	337	288	180	53	348	659	137	36	67	0.3	2,748
2009	892	562	508	344	295	102	371	929	277	58	131	0.3	3,995
2010	902	626	585	406	409	101	450	1,168	315	83	153	0.4	4,647
2011 Est.	820	639	517	703	358	80	391	987	247	69	131	0.1	4,480

Sources: Treasury TIC Surveys; Pre-2011 long-term bond and equity position calculations as per Bertaut & Tryon (2007).
Note 1: Data for 2011 are based on TIC SLT surveys; other years are based on TIC S and annual benchmark surveys.
Differences in survey sample sizes and reporting thresholds may result in some discrepancies.

4. **The much larger role of US holdings of foreign stocks relative to bonds is also highlighted by information on the share of foreign markets held by US residents** (Table 2). On the portfolio equity side, the shares have remained broadly stable, with US investors having a proportionately large presence in Canada as well as Europe. On the bond side, the Canadian bond market is the only one where the share of US investors is over 10 percent, and the Australian market the only one where the US share of the market has increased materially since the pre-crisis period. Despite increased flows to the region, US residents' bond market share in Latin America remains close to its 2006 level.

Table 2. U.S. holdings relative to market capitalization (%)

Common stocks

	2005	*2006*	*2007*	*2008*	*2009*	*2010*
Euro Area	…	…	12	12	14	14
UK	18	18	18	19	19	19
Canada	17	18	16	16	16	18
Total Asia	…	…	6	7	6	7
China	…	3	2	2	2	2
Japan	10	11	12	11	11	11
Lat. Am.	…	…	9	8	9	8
Africa	…	…	5	5	6	6
Australia	…	9	10	9	9	10

Sources: Treasury, Annual Survey of US Holdings of Foreign Securities.

Long-term debt

	2005	*2006*	*2007*	*2008*	*2009*	*2010*
Euro Area	1.6	1.8	1.9	1.4	1.6	1.6
UK	6.4	6.6	6.3	4.0	4.5	4.7
Canada	12.1	11.7	11.1	11.1	11.6	11.8
Total Asia	..	..	..	..	..	..
China	0.2	0.1	0.1	0.1	0.0	0.1
Japan	0.4	0.5	0.7	0.5	0.3	0.3
Lat. Am.	6.6	4.9	4.2	3.9	4.3	4.9
Africa	..	..	..	..	..	..
Australia	6.0	6.1	5.5	6.4	7.3	7.3

Sources: Treasury, BIS, staff calculations.

US Portfolio Flows into Domestic Securities

5. **US investors also adjusted their positions in domestic securities following the financial crisis**. Residents' Treasury purchases increased sharply, despite the large decline in rates, while purchases of GSE debt, MBS securities and corporate bonds were scaled down. During this period, there was a reduction in the overall supply of short-term corporate debt and GSE bonds—commercial paper outstanding fell from $2.2 trillion in the summer of 2007 to $980 billion in May 2012 and agency MBS issuance has fallen from a peak of $1.7 trillion in 2009 to $1.2 trillion in 2011. Still, some active deleveraging was evident—the share of commercial paper held by US investors fell from 77 percent in 2005 to 63 percent in 2011, while agency debt and MBS, 84 percent to 73 percent. Another contributing factor to the dynamics of investor flows was the Federal Reserve's asset purchase programs. The significant increases in its purchases of Treasuries and MBS securities boosted the Federal Reserve's Treasury and MBS holdings to as high as 16 percent relative to total market size (Table 3 below).

Table 3. Purchases of U.S. securities by domestic and foreign residents

	Net Purchases			Percent of Total Outstanding			
	2005-07	*2008-10*	*2008-11*	*2005*	*2007*	*2010*	*2011*
US residents excl Fed	1,442	1,067	1,258				
Treasury securities	145	2,061	2,199	42	39	44	39
GSE	706	67	284	84	79	70	73
US corporate bonds	1,543	-276	-177	77	72	75	75
Commercial paper	325	-716	-751	77	77	63	63
Equities	-1,278	-69	-297	90	89	87	86
Federal Reserve	23	1,421	1,865				
Treasury securities	23	281	923	16	15	10	16
GSE	-	1,140	942	0	0	16	13
US corporate bonds	-	-	-				
Commercial paper	-	-	-				
Equities	-	-	-				
Foreign residents	2,901	1,507	1,586				
Treasury securities	561	1,921	2,207	42	47	47	46
GSE	607	-544	-600	16	21	14	14
US corporate bonds	1,294	-185	-251	23	28	25	25
Commercial paper	68	-14	-68	23	23	37	37
Equities	372	330	298	10	11	13	14

Source: Flow of Funds

Foreign Portfolio Flows into US Securities

6. **Meanwhile, since the financial crisis, foreign portfolio flows into the US have declined significantly**. Total portfolio flows to the US fell from roughly $2.9 trillion during 2005–07 to $1.5 trillion during 2008–11 (table 3 above). During the post-crisis period, bond inflows into the US fell sharply. Large inflows into Treasuries were more than offset by outflows in agencies, MBS and corporate bonds, a pattern not dissimilar from US residents' domestic purchases. Meanwhile, foreign

equity flows into the US fell as well, though by a smaller magnitude, from $372 billion in the pre-crisis period to $330 billion post crisis.

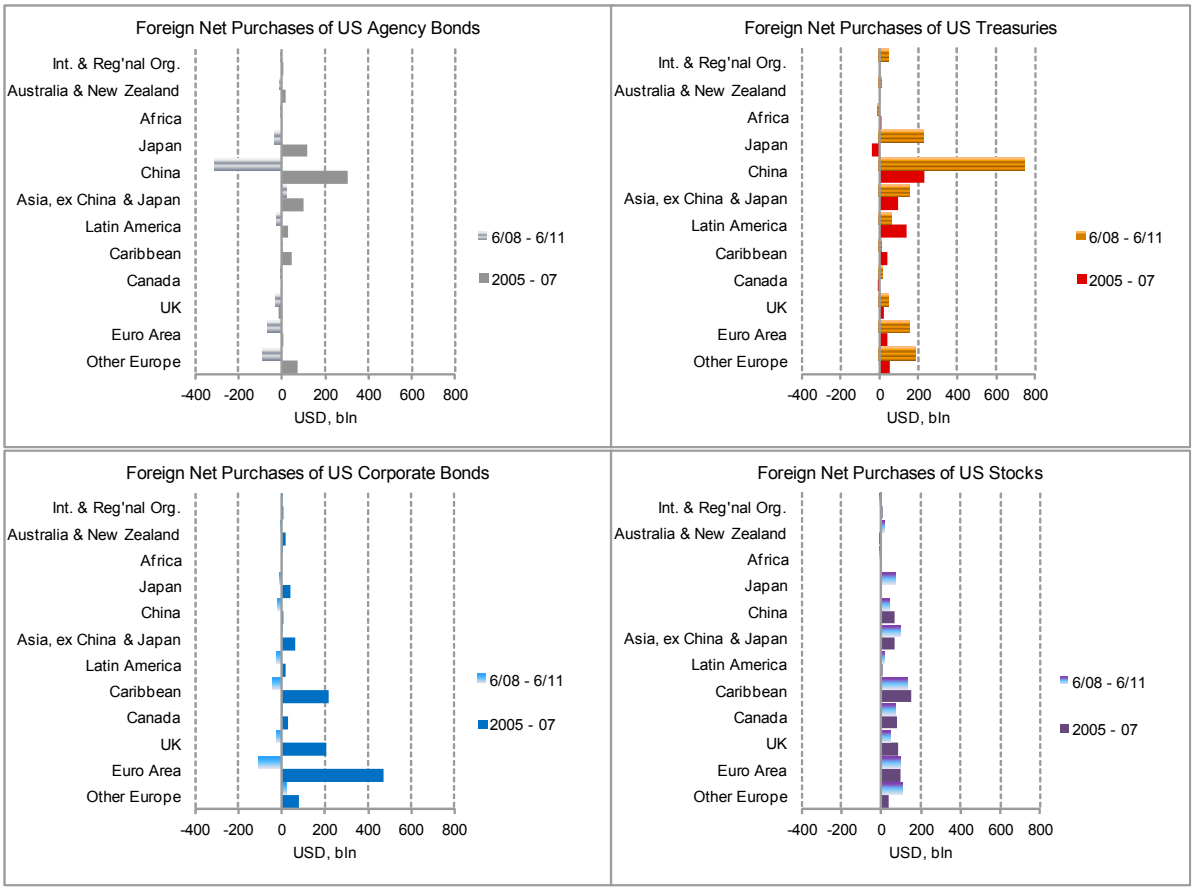
7. **Net foreign purchases of US securities shifted heavily towards US Treasuries after the crisis**. In the pre-crisis period, foreign investors were large net buyers of agency securities and corporate bonds, with purchase amounts there far surpassing those for equities and Treasuries (Table 3 above and Chart 2 below). In particular, there were large purchases of US agency securities from Asian investors, while European investors and Caribbean banking centers purchased large amounts of corporate bonds, including a sizable volume of asset-backed securities. In the post-crisis period, foreign investors became net sellers of agency securities and corporate bonds. This change in flows likely reflected, in part, the sizable decline in private and agency issuance of MBS as well as the Federal Reserve's large purchases of MBS, as noted above. Meanwhile, investors increased their US Treasury purchases significantly, with net flows into Treasuries totaling around $1.9 trillion, while the size of foreign equity purchases was significantly smaller. Preliminary data for 2011 suggests a further increase in foreign holdings of US Treasuries.[4]

Summary

8. **The pattern of aggregate portfolio investment flows since the financial crisis offer little evidence that low US interest rates have been associated with large outflows by US investors**. Nor has the decline in US interest rates deterred foreign portfolio inflows. While foreign portfolio purchases of US securities fell on net in the post-crisis period, purchases of Treasuries have risen sharply. One conjecture is that while the decline in policy rates and unconventional easing measures tend to depreciate the dollar and encourage portfolio outflows from the US, they took place in response to shocks (a weaker US and global environment, higher risk aversion, increased demand for liquidity) that tend to discourage purchases of foreign portfolio instruments. Prima facie the significant changes in the destination of flows reflect changes in relative growth prospects post-crisis as well as relative cyclical conditions. In particular, large increases in portfolio flows into Treasuries in the post-crisis period from US and foreign residents—Table 3—underscored safe-haven considerations. Meanwhile, the reduction in US investors' euro area and UK bond holdings and their purchases of bonds from markets with brighter growth outlooks, including Canada, Latin America, and Australia suggested that growth prospects and the potential for higher returns have also influenced portfolio decisions.

[4] Data for 2011 holdings are based on preliminary TIC SLT surveys.

Chart 2. Foreign Net Purchases of US Securities



Sources: Treasury TIC data, Federal Reserve Board.
Flows calculations as per Bertaut & Tryon (2007).

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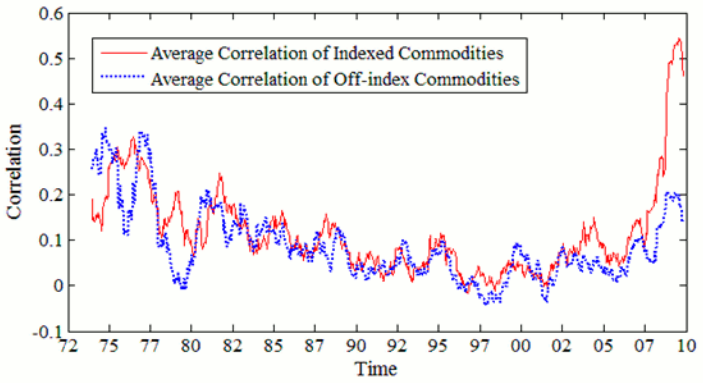
12. The Impact of Global Liquidity on Commodity Prices[1]

The relationship between global funding conditions and commodity prices is investigated in a Bayesian VAR framework. After identifying supply versus demand-driven liquidity shocks using sign restrictions, oil prices are found to be negatively correlated with global funding costs. A decomposition of the real price of oil based on a sign-restricted structural VAR model suggests that global liquidity shocks only explain about 7.5 percent of the variation in oil prices during 1999Q1–2011Q3, with the bulk of movements explained by oil market supply/demand conditions. There is little evidence of financialization of non-oil commodity markets.

1. **Commodity futures, as an asset class, offer a diversification benefit to stocks and bonds and therefore are affected by global funding conditions**. While mortgage backed securities (MBS) and related structured products are held by large financial institutions, commodities investors tend to be long-only institutions (such as pension funds and insurance companies) who seek portfolio diversification through the purchase of investments linked to indices of commodity prices. Tang and Xiong (2010) identify a substantial increase in the correlation between prices of indexed commodities since 2003 (with the liberalization of US markets that fostered the growth of commodity linked Exchange Traded Funds) provide evidence for the "financialization" of commodities (i.e., when commodities are bought for hedging purposes (Figure 1)). Studying whether this financialization has led to price increases and identifying whether these price changes are supply- or demand-driven, helps clarify the role of funding conditions in determining commodity prices.

Figure 1. Average Correlations of Indexed and Off-Index Commodities



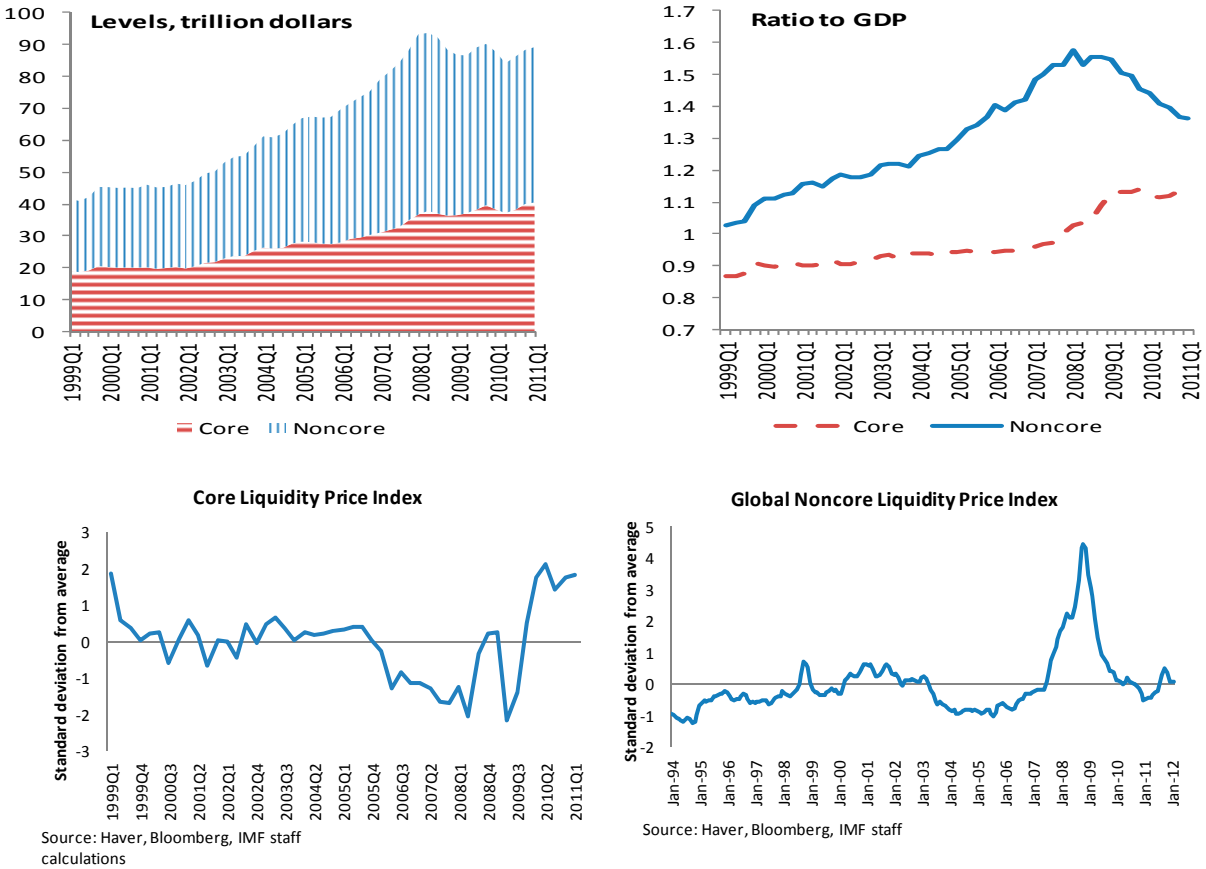
Average of one year rolling return correlations between 19 indexed commodities and the nine off-index commodities that have futures contracts traded in the US.

Source: Tang and Xiong (2010).

[1] Prepared by Andrea Maechler and Mehdi Raissi (SPR).

2. **Global liquidity is defined as the funding liabilities of the financial institutions in the United States, the United Kingdom, the Euro Area, and Japan** (Figure 2). A full description of liquidity measures can be found in Chen et al. (2012), but the analysis below employs the following concepts: (i) "Core" global liquidity, defined as the sum of total resident deposits in commercial banks and other depositary corporations—this measure approximates traditional monetary aggregates, such as M2 or M3 depending on national definitions; (ii) "noncore" liquidity, the sum of debt securities and nonresident deposits in these countries and represents collateral-based funding (e.g., wholesale funding) typically not captured in traditional monetary aggregates; (iii) the price of core liquidity, defined as the spread between domestic interest rates on deposits with a maturity of up to one year and the 6-month interbank offered rate; and (iv) a price index for noncore liquidity based on the methodology of Matheson (2011).

Figure 2. Total G4 Liquidity in Trillion Dollars, as a Ratio to GDP, and Price Indices



Source: Haver, Bloomberg, IMF staff calculations

Source: Haver, Bloomberg, IMF staff

3. **The impact on commodity prices of a supply/demand-driven global funding shock is analyzed using a sign-restricted Bayesian VAR model** (as in Uhlig, 2005). The model is estimated using quarterly data over the period 1999Q1–2011Q3, and consists of the following variables: quantity and price series for core and noncore liquidity, the real price of oil, VIX volatility index, and

an index of real economic activity.[2] Shocks to global liquidity are defined as follows: a positive supply shock is identified when the quantity of liquidity rises while its price falls (i.e., a rightward shift of the supply curve), whereas a positive demand shock occurs when both the quantity and price of liquidity rise together (i.e., a rightward shift of the demand curve).

4. **The model suggests that a loosening in global liquidity conditions (i.e., lower funding prices) tends to be associated with a rise in oil prices**. Furthermore, oil prices are sensitive to funding conditions in both core and noncore liquidity, but for different reasons. Key findings include:

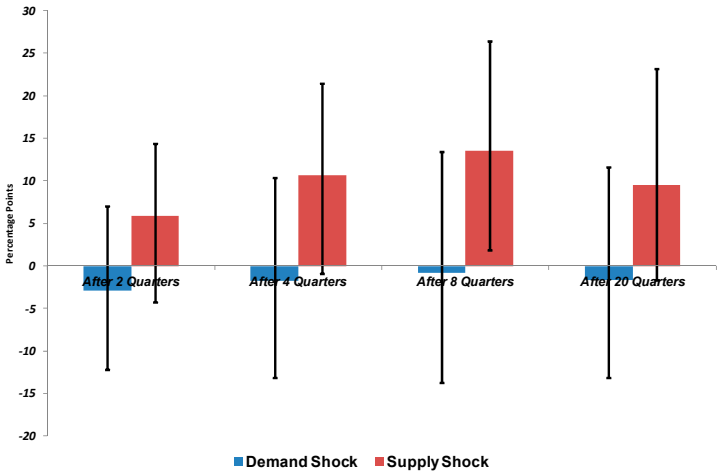
- *A positive supply shock to "noncore" global liquidity is associated with upward pressure on oil prices* (Figure 3). When financial conditions loosen, investors are encouraged to buy commodity-linked products in search of higher real returns. This is consistent with the Great Moderation period, where a low interest rates environment induced financial institutions to search for higher-yielding assets, including oil (Etula, 2009). The impact on oil prices of a supply shock to "core" liquidity goes in the same direction but is not statistically significant (Figure 4).

- *Tighter financial conditions resulting from a positive demand shock to global liquidity are associated with lower oil prices*; *but, these results are not statistically significant*. When the demand for funding rises, financial conditions tighten, increasing the cost of investing in commodity-indexed products and depressing real economic activity, putting further downward pressure on oil prices. This is particularly true in the case of core funding, as banks tend to pass-through higher funding costs onto lending rates. A rise in the demand for noncore funding, on the other hand, can be less price-sensitive, as it can be more easily met by an endogenous creation of noncore liquidity (e.g., Asset Backed Securities, leveraged repos).

- *There is little evidence for "financialization" of the non-oil commodity markets*. Global liquidity shocks do not seem to affect the price of non-oil commodity prices (Figure 5). While positive demand shocks tend to reduce the price of non-oil commodities (similar to their impact on oil prices), positive supply shocks raise the price of non-oil commodity prices in the first year but reduce it afterwards.

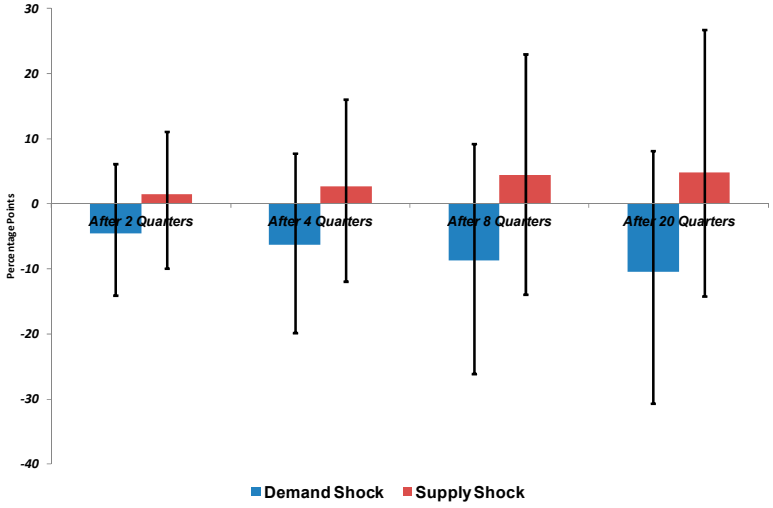
[2] The real oil price series is based on refiner acquisition cost of imported crude oil, provided by the US Department of Energy and deflated by the US CPI. VIX is the Chicago Board Options Exchange Market Volatility Index. The index of real economic activity is taken from Kilian (2009) and is based on dry cargo single voyage ocean freight rates and is explicitly designed to capture shifts in the demand for industrial commodities in global business markets.

Figure 3. Cumulated Impulse Response of Oil Prices to a Positive Supply/Demand Shock to "Non-Core" Global Liquidity



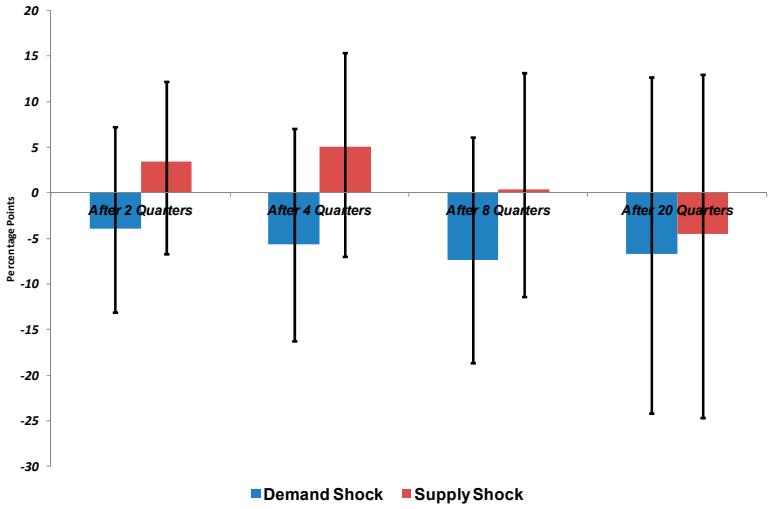
Note: Depicts the effects of positive demand and supply shocks to "noncore" global liquidity on commodity prices after 2, 4, 8, and 20 quarters with 16% and 84% confidence bounds.

Figure 4. Cumulated Impulse Response of Oil Prices to a Positive Supply/Demand Shock to "Core" Global Liquidity



Note: Depicts the effects of positive demand and supply shocks to "core" global liquidity on commodity prices after 2, 4, 8, and 20 quarters with 16% and 84% confidence bounds.

Figure 5. Cumulated Impulse Response of Non-Oil Commodity Prices to a Positive Supply/Demand Shock to Global Liquidity



Note: Depicts the effects of positive demand and supply shocks to global liquidity on "non-oil" commodity prices after 2, 4, 8, and 20 quarters with 16% and 84% confidence bounds.

Historical Decomposition of the Real Price of Oil

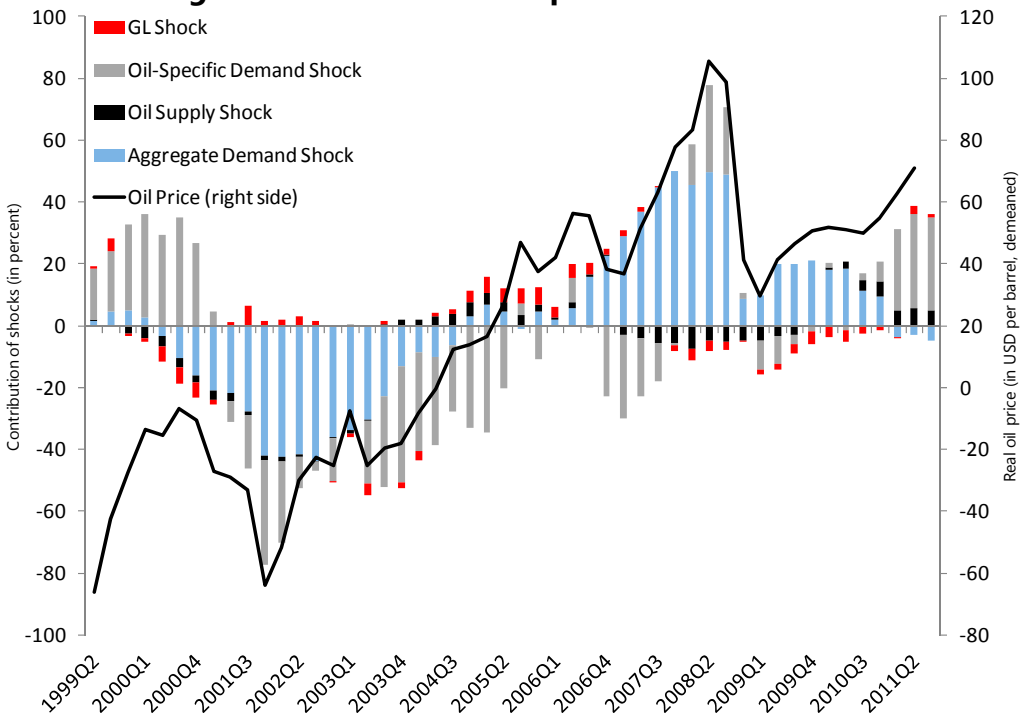
5. **To what extent do global liquidity shocks push the price of oil above/below the level warranted by fundamental forces of oil supply and demand**? The role of global liquidity shocks in determining the real price of oil relative to other drivers of oil prices is analyzed using a sign-restricted structural VAR model with five variables: percent change in global crude oil production, an index of real economic activity as in Kilian (2009), the real price of oil, the quantity and price of global funding. The structural VAR is estimated using quarterly data over 1999Q1-2011Q3, including one lag of all endogenous variables.

6. **Four different types of shocks are identified**: an oil supply shock, an oil demand shock driven by economic activity, an oil-specific demand shock, and a global liquidity shock. A negative *oil supply shock* is an exogenous shift of the oil supply curve to the left, lowering oil production and increasing oil prices—for example, an exogenous oil production disruption caused by geopolitical tensions in the Middle-East. In contrast, a positive *oil demand shock driven by economic activity*, represented by an upward shift of the oil demand curve, is a shock that increases both oil production and oil prices. The surge in oil demand on the back of strong economic growth in emerging market economies would be an example. An *oil-specific demand shock* is an oil shock that is not driven by stronger economic growth, but rather by expectations of future changes in oil conditions. An increased demand for oil inventories due to an expected tightening in the future oil supply would be an example of such a shock. Finally, *a global liquidity shock* is identified based on a set of theoretical sign restrictions on the quantity and price of global funding, as explained above.

7. **A historical data decomposition can be used to show the relative cumulative contribution of the different shocks to the real price of oil** (Figure 6). The shocks are disentangled by relying on a set of sign restrictions derived from a simple supply-demand scheme of the oil and global funding markets. The empirical results indicate that oil price movements are mostly explained by oil demand shocks and, to a lesser extent, oil supply shocks. In particular, the gradual run-up in oil prices during 2004 to early 2008 is mainly driven by oil demand shocks on the back of booming economic activity, compounded by an increasingly tight oil supply. Similarly, the sharp drop in oil prices in the second half of 2008 is mainly explained by the sharp fall in economic activity in the midst of the global financial crisis.

8. **The impact of global liquidity shocks on the real price of oil has been relatively limited**, explaining about 7.5 percent of the variation in oil prices during the sample period. Nonetheless, positive global liquidity shocks have contributed to the steep oil price run-up in 2004 to early 2008, by pushing oil prices above the levels warranted by oil supply and demand shocks. This is consistent with the massive inflows into exchange-traded funds linked to oil that was witnessed around this time. In the aftermath of the financial crisis and until early 2011, global liquidity shocks turned negative, dampening the impact on oil prices.

Figure 6. Historical Decomposition of the Oil Price



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IV. CHINA

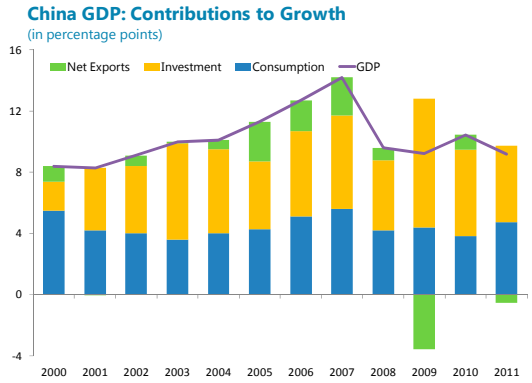
13. Investment-Led Growth in China: Global Spillovers[1]

Over the past decade, China's growth model has become more reliant on investment and its footprint in global imports has widened substantially. Several economies within China's supply chain are increasingly exposed to its investment-led growth and face growing risks from a deceleration in investment in China. This note quantifies potential global spillovers from an investment slowdown in China, finding that a one percentage point slowdown in investment in China is associated with a reduction of global growth of just under one-tenth of a percentage point. The impact is about five times larger than in 2002. Regional supply chain economies and commodity exporters with relatively less diversified economies are most vulnerable to an investment slowdown in China. The spillover effects also register strongly across a range of macroeconomic, trade, and financial variables among G20 trading partners.

A Growth Model Increasingly Dependent on Investment

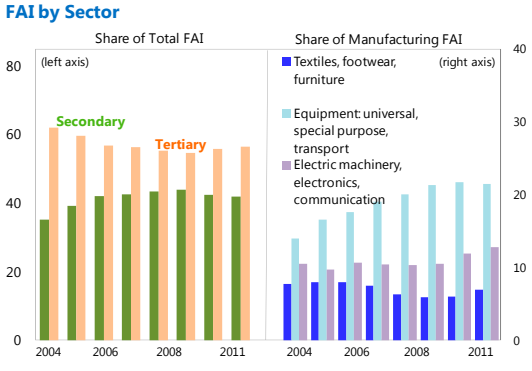
A growing reliance on investment…

1. **China's growth model has become increasingly dependent on investment over the past decade**. Investment contributed around one-half of China's GDP growth in the 2000s, with particularly large contributions toward the end of the decade.



…spread over secondary and tertiary sectors

2. **In part this reflects the step increase in infrastructure investment during the 2008–2010** stimulus response to the global financial crisis. Investment as a share of GDP increased by close to 6 percentage points over this period (relative to pre-crisis), reaching 48 percent of GDP in 2010. But increasingly it appears that other forces, including the ongoing urbanization process the more recent emphasis on social housing

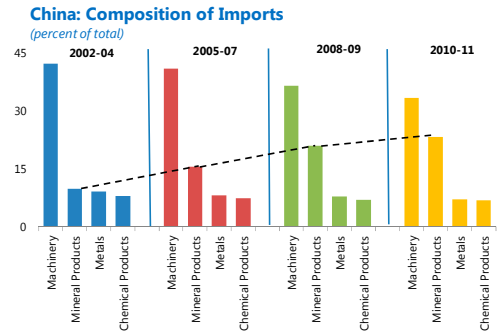


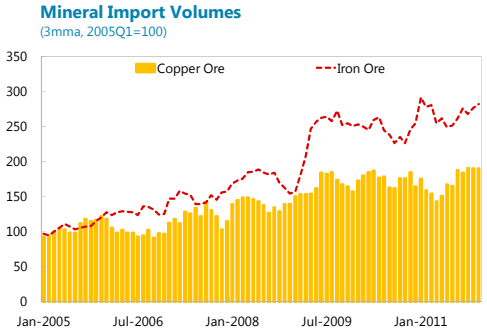
[1] Prepared by Malhar Nabar and Ashvin Ahuja, with helpful inputs from Steve Barnett, Mitali Das, Il Houng Lee, Andre Meier, Alla Myrvoda, and Papa N'Diaye.

construction, and capacity building in high-end manufacturing and services, are also contributing to investment growth.

… and accompanied by shifts in the import basket

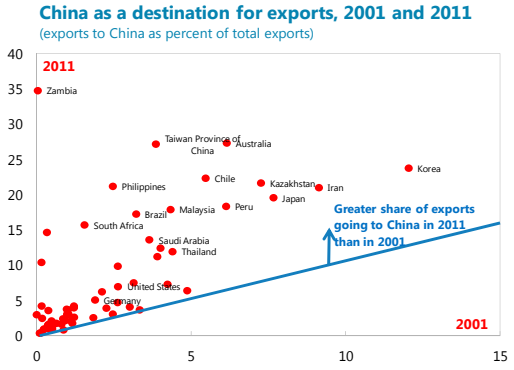
3. **Associated with these changes in the profile of investment are important shifts in China's import basket**. As more manufacturing gets onshored, the share of machinery imports has been gradually declining. At the same time, with China increasingly drawing in larger volumes of minerals and metals, their share of total imports has grown steadily.



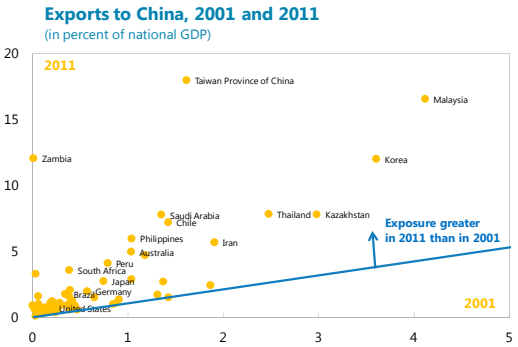


China's importance to trading partners in its supply chain has grown substantially over the past decade

4. **These developments have had a noticeable impact on global trade flows**. Major exporters of commodities, capital goods, parts, and components have been sending an increasing fraction of their exports to China over the course of the decade. In part this reflects the fact that supply chains have been increasingly routed through China as the final stage of assembly (see IMF 2012 for more details).



5. **The importance of exports to China, when assessed relative to trading partner GDP, shows even sharper increases for several economies**. This ratio has, on average, quadrupled across the decade. Particularly exposed are Asian regional economies such as Taiwan Province of China, Malaysia, and Korea—all of which are important exporters of capital goods, parts, and components for final assembly in China.



Assessing Exposures to Investment-Led Growth in China

A growing risk to trading partners

6. **China's growing reliance on investment-led growth raises questions about how the new capacity will be used**. If the capacity finds its way onto world markets by way of new exports and is perceived to put downward pressure on global prices, it would create the potential for retaliatory trade actions which could eventually come back to hurt the Chinese economy and slow investment (see Guo 2011). Another possibility is that the new capacity remains underutilized, with adverse effects on bank balance sheets and credit conditions, adversely affecting the financing of subsequent investment.

7. **A rapid investment slowdown in China under either of the latter two outcomes will undoubtedly have a global impact given China's size and systemic importance**.

Quantifying spillovers

8. **To get a sense of the potential magnitudes**, the spillover from China on trading partner j is measured as

$$\text{China spillover}_{j,t} = \text{exCHN}_{j,t} * \text{China Fixed Investment growth}_t$$

where

$$\text{exCHN}_j = \left(\frac{\text{Exports to China}}{\text{GDP}}\right)_j$$

and $\text{China Fixed Investment growth}_t$ is measured as the annual percent change of real gross fixed capital formation from the national accounts. This spillover measure varies across countries in a given year based on their export exposure to China and also varies over time based on fluctuations in China's fixed investment growth. By construction, it only measures the influence of Chinese activity on other economies through the direct trade channel. Indirect trade exposures through vertically-integrated intermediate economies are not captured. Another concern with this measure is that it does not reflect financial exposures, which would also have a bearing on growth in trading partners. However, with the comprehensive system of capital controls in place and the dominance of domestic sources of financing, the financial spillover channel is likely to be limited.

Estimating the impact of spillovers

9. **The effect of the spillover from China on trading partner growth is estimated using a broad** sample of 64 economies exposed to China through the export channel described above. The sample covers the period of China's membership in the WTO (2002–11) and includes the full set of OECD economies, emerging markets classified under the MSCI index, and key commodity producers. The main specification is

$$GDP\ growth_{j,t} = \alpha_j + \beta_1 GDP\ growth_{j,t-1} + \beta_2 China\ spillover_{j,t} + \beta_3 ToT_{j,t} + \beta_4 Volatility_{j,t} + e_{j,t}$$

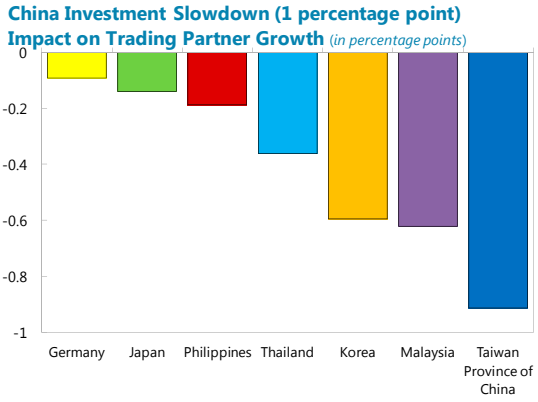
Differentiating between manufacturing and nontradables fixed investment

10. **The regression is estimated using various measures of fixed investment growth in China:** overall, manufacturing, and nontradables.[2] Manufacturing and nontradables fixed investment are calculated by applying shares from fixed asset investment data (available only from 2003 onward) to the national accounts series on real gross fixed capital formation. This breakdown allows for a comparison of likely effects from a slowdown in investment concentrated in manufacturing versus a deceleration concentrated in nontradables.

Effects of An Investment Slowdown in China

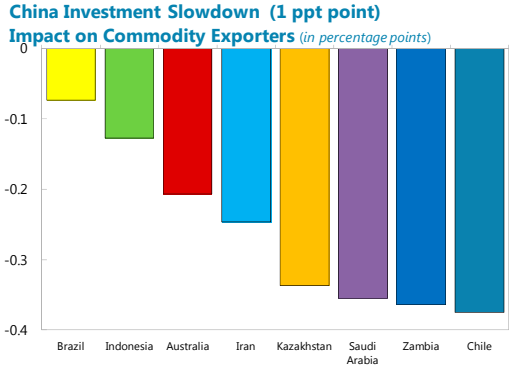
Regional supply chain economies are highly vulnerable …

11. **The impact of China's investment-led growth** on trading partners has grown over time as China's growth model tilts more toward investment and its global footprint of imports widens (Appendix A, Tables 1–4). Aggregating across all 64 economies (weighted by their PPP shares), the impact on global growth of a one percentage point slowdown in investment in China is just under one-tenth of a percentage point. The impact is about five times larger than in 2002. The most heavily exposed economies are those that lie within the Asian regional supply chain such as Taiwan Province of China, Korea, and Malaysia. The results from Table 4 (estimated on a sample covering the global financial crisis and the stimulus response in China) suggest that if investment growth declines by 1 percentage point in China, GDP growth in Taiwan Province of China for example falls by slightly over nine-tenths of a percentage point. Among the advanced economy exporters of capital goods, Japan suffers a decline of just over one-tenth of a percentage point in response while growth in Germany declines by a slightly smaller amount.



As are commodity exporters with relatively less diversified economies

12. **Among commodity exporters, the impact of a slowdown in investment growth in China is likely to be largest on mineral ore exporters with relatively less diversified economic structures and a higher concentration of exports to China**. In response to a 1 percentage point slowdown in investment growth in China, the estimated effect on Chile's growth is a reduction of close to two-fifths of a percentage point. By contrast, the larger commodity exporters such as Australia and Brazil with more diversified economies suffer

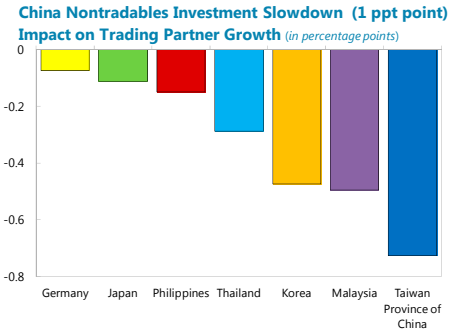


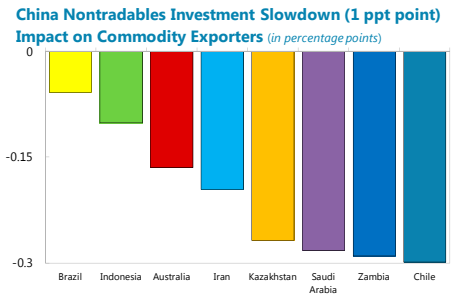
[2] The nontradables sector is defined to include utilities, construction, transport and storage, IT, wholesale and retail trade, catering, banking and insurance, real estate, leasing and commercial services, education, health care, sport and entertainment, and public administration.

relatively smaller declines in growth.

A slowdown concentrated in manufacturing has similar implications, but impacts are smaller for a slowdown concentrated in the nontradables sector

13. **A sectoral decomposition of China's overall fixed investment into manufacturing and nontradables shows that the magnitude of spillovers from a slowdown in manufacturing NFI are broadly similar to the effects from a slowdown in overall NFI** (Table 4). The impact associated with a slowdown concentrated in nontradables is considerably smaller. The impact on Taiwan Province of China's growth is around three-fourths of a percentage point compared to slightly greater than nine-tenths of a percentage point in the case of a generalized investment slowdown. Similarly, Chile's growth declines by around a third of a percentage point in response to a slowdown concentrated in tertiary sector investment in China (compared to two-fifths in the broader investment slowdown described above).





14. **The results also suggest that China's manufacturing investment reflects the influence of the global business cycle, but nontradables investment has a spillover impact above and beyond the effect of global growth** (Table 5). Once a control for global growth excluding China is added to the regression, the spillover effect via manufacturing fixed investment in China is no longer significant.

Implications of a Handoff to Consumption

Due to its low import intensity, consumption growth in China appears to have negligible spillover effects on trading partner growth

15. **If the capacity currently being installed in China is absorbed domestically** (which would require consumption to accelerate in response to the structural reforms envisaged in the 12th Five-Year Plan), a smooth hand-off from investment to consumption-led growth can be achieved. China's growth would moderate into the medium term, but would still remain above 8 percent as outlined in the rebalancing scenario in IMF 2011.

16. **The benefits of such an outcome for consumer goods exporters are, however,** likely to be small. China's share in global consumer goods imports has increased at a slower pace than its share in global consumption over the past fifteen years. It currently plays a small role as an importer

of consumer goods, accounting for only 2 percent of global consumer goods imports (see IMF 2012 for more details).

17. **The panel regression approach using the broad sample of 64 economies confirms that this is the case**. The low import intensity of consumption in China suggests that the direct spillover effect from consumption growth on trading partner growth is negligible. A similar exercise to the one outlined above, but which instead quantifies potential spillovers from consumption growth in China, shows that the effects on trading partner growth are insignificant (Appendix A, Table 6).

Effects of an Investment Slowdown on G20 Macro Indicators

18. **A complementary approach presented below uses a factor-augmented VAR (FAVAR) to gauge the domestic and global spillovers of a slowdown in China's FAI investment**. The FAVAR framework is extended into a two-region model that allows China to interact with the other G20 economies. The analysis captures the feedback from China to the rest of the world, and vice versa, over time. It also captures the spillover effect among the rest of the G20 economies from a specific event originated in China.

19. **Market participants monitor hundreds of economic variables in their decision making process, which provides motivation for conditioning the analysis of their decisions on a rich information set**. The FAVAR framework extracts information from the rich data set to gauge the impact of particular forces that may not be directly observable. These "forces" are treated as latent common components, which are inter-related, and their impacts on economic variables are traced through impulse response functions. By accounting for unobserved variables, there is a better chance that findings based on spurious association can be avoided.

20. **More detailed description of the model and estimation strategy can be found in the appendix of Background Paper #15** "The Spillover Effects of a Downturn in China's Real Estate Sector". Briefly, the model is a stable FAVAR in growth (except for balances and interest rates) with 5 common factors for each region (China and the rest of the G20 economies) and China's fixed asset investment (FAI). The model uses one lag. The Cholesky factor from the residual covariance matrix is used to orthogonalize the impulses, which imposes an ordering of the variables in the VAR and treats investment as exogenous in the period of shock. The results are robust to re-ordering within factor groups.

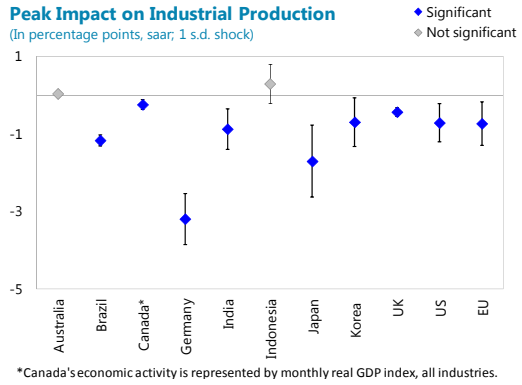
21. **The data set is a balanced panel of 390 monthly time series from the G20 stretching** from 2000M1 to 2011M9, with 68 China-specific variables and 322 from the rest of the G20. The sample contains at least one full cycle of investment in China. It starts from the period right before China's entry into the WTO and covers the time when it became increasingly integrated with the world economy.

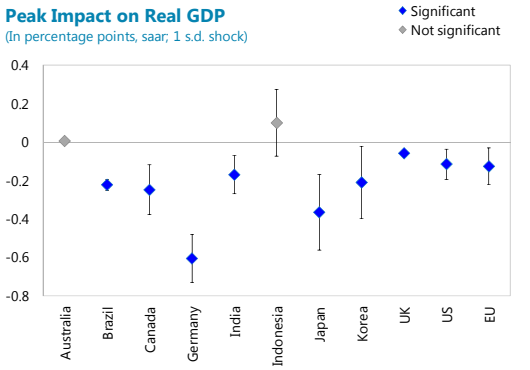
22. **Since the model is in growth, the experiment assumes an exogenous, temporary, *one-standard-deviation* growth shock to China's FAI**. The shock dampens within 3 quarters and

dissipates fully after around 40 months. Specifically, this is a one-time 15-percentage-point (seasonally adjusted, annualized) drop in FAI growth that reverts to trend growth largely within 7–8 months.[3] While this is a temporary, negative growth shock, the decline in FAI level is permanent. The shock is approximately equivalent to a 2½-percent drop from baseline in real FAI level 12 months after. The analysis does not assume policy response beyond that which was already in the sample. Twenty-four-month-peak impacts are reported with standard error bands in the charts below. Impacts on levels 12 months after the shock, in percent below baseline, are also derived and reported for comparison in Appendix B, Tables 1–2.

Global spillovers from a temporary shock to China's FAI growth last for approximately 5-8 quarters

23. **A temporary shock to China's FAI growth would reverberate around the world**, with the spillover impacts on G20 economies dissipating after approximately 5–8 quarters. In this exercise, the approximate impact on GDP growth would vary with the size of industrial production-to-GDP ratio in each economy.[4] The implied peak impact on PPP-weighted G20 GDP growth is -0.2 percentage point, which translates to around 0.1 percent below baseline at 12 months after the shock originated in China (see Appendix B, Table 1). Capital goods manufacturers that have sizable direct exposure to China (through exports to China in percent of own GDP) and are highly integrated with the rest of the G20—therefore sharing adverse feedback from a negative shock in China with other trading partners such as Germany and Japan—would see more of the impact on economic activity. One year out, the impact is also sizable for Canada. The impact on Indonesia's output is not statistically significant over the entire period. This is likely because coal exports to China have become important only over the past few years.





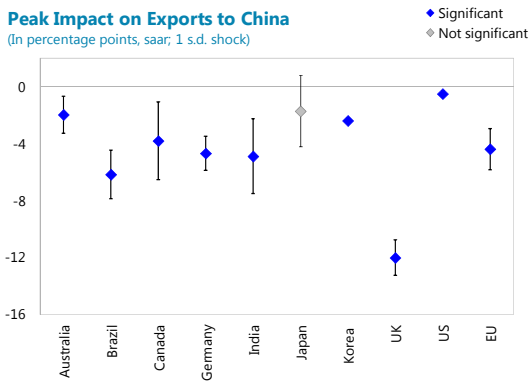
24. **The results also show that global trade activity would decline**. Total exports and total imports for every G20 economy would weaken, which suggests that economies that derive significant benefit from global trade expansion and have had deeper links via supply chain countries

[3] One standard deviation shock is equivalent to 1.2 percentage points in month-over-month, seasonally adjusted, growth rates.

[4] Industrial production is defined differently from country to country. The OECD definition includes production in mining, manufacturing, and public utilities (electricity, gas, and water), but excludes construction.

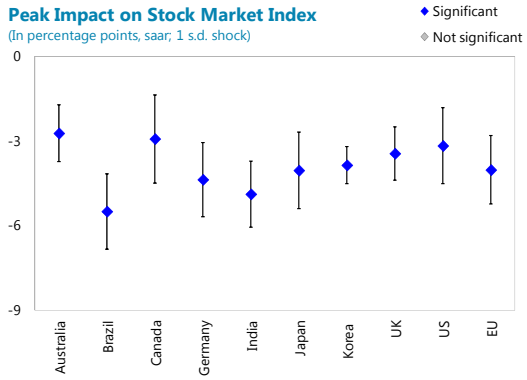
over the past decade, such as Germany and Japan, would be harder hit in the second round (see Background Paper #15). The impact on Korea's GDP peaks within the first 2 quarters and fades away more quickly, which is consistent with the fact that Korea's direct exposure to China is large but second round effects through supply chain countries are smaller than Japan and Germany.

Spillover effects on industrial production are relatively moderate for economies that rely less on demand from China



25. **The growth slowdown of exports to China for India, Brazil, and Korea mirrors the impacts on their industrial production growth**. For UK, however, where exports to China slows the most, they are not an important component of final demand, and the impact on economic activity looks moderate.[5] Brazil, whose exports to China are agricultural and mineral commodities heavy, would also experience nonnegligible spillover effects on export growth. Australia's relatively large direct exposure to China should imply a substantial direct impact, but there seems to be other forces (e.g., the AUD exchange rate behaves as a shock absorber) that blunt effect on Australia's industrial production, which accounts for around 20 percent of GDP. Nevertheless, other indicators, such as employment growth and *total* import growth (not shown here), point to a slowdown in Australia's economic activity. Overall trade expansion with China would also slow as global and China demand growth weakens.

The impact on stock prices is tangible



26. **The spillover effects are captured in asset prices as well**. Specifically, the impact on the stock market indexes in G20 economies, would be as large as 5–5½ percentage points in India and Brazil and between 4-4½ percentage points in the Euro Area, Germany, and Japan—and would last for as long as 4-5 quarters.

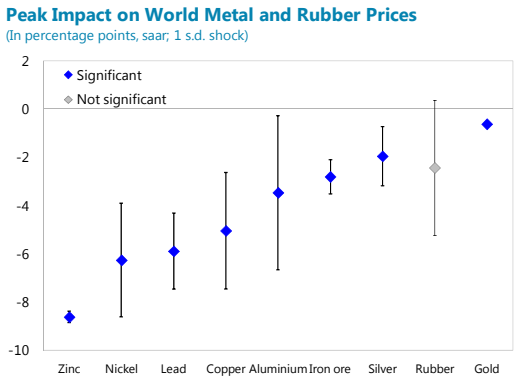
[5] Exports to China are mostly in machinery, equipment, and industrial supplies in the case of UK and mineral commodities and primary metal products in the case of India. Canada's exports to China are more diversified in mineral and manufactured commodities.

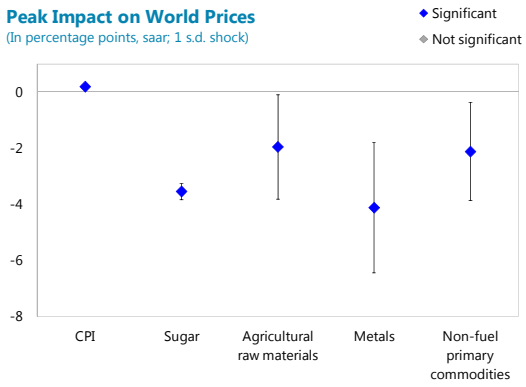
Flatter yield curves signal concerns about future global growth

27. **A general decline in sovereign bond spreads (cumulative over the first 12 months after** impact) seems to signal concerns about future global growth, complementing the immediate impacts on industrial production shown earlier. In the US's case, the initial decline in treasury bond spreads is reversed around 3 quarters after the shock, consistent with the US's special status as the ultimate safe haven destination for financial investment. The model shows a weak relationship between Australia's growth prospects and a China investment shock, which is consistent with the result on industrial production growth above.

A slowdown in China FAI would lead to lower non-fuel commodity price than baseline, but the impact on overall global inflation is modest

28. **Even as nonfuel primary commodity price inflation—especially metal price inflation**—retreats, the impact on global inflation appears almost negligible. Global growth slowdown, initiated by a temporary China investment growth slowdown, would lead to a drop in iron ore, aluminum, copper, lead, nickel, and zinc price growth of as much as 3–9 percentage points, respectively. This is equivalent to a decline in price levels of around 2–5½ below baseline levels, one year out (see Appendix B, Table 2). It is unclear how crude oil prices would be affected in this exercise (the impulse responses show a drop in crude price growth, with peak at around 3 quarters after impact, but are not statistically significant).





29. **The model implies that China's investment drive has had a significant impact on construction-related metal prices between 2008 and 2011**. Appendix B, Table 4 reports the extent of China's contribution to metal price growth during 2008–11 (Global Financial Crisis), with the counterfactual (no investment drive) scenario assuming China's real gross fixed capital formation had grown at the same pace as real GDP so that investment-to-GDP ratio was maintained at end-2007 level.

Summary

30. **A rapid investment slowdown in China is likely to have large spillover effects on a number of China's trading partners**. At the macro level, each percentage point deceleration in China's investment growth is estimated to subtract between one-half and nine-tenths of a percentage point from GDP growth in regional supply chain economies such as Taiwan Province of China, Korea, and Malaysia. Major commodity producers with relatively large exposures to China

such as Chile and Saudi Arabia are also likely to suffer substantial growth declines in response to an investment deceleration in China.

31. **The spillover effects from an investment slowdown in China also register strongly** across a range of macroeconomic, trade, and financial variables among G20 trading partners as well as world commodity prices. Within this group, a China FAI decline would have a substantial impact on capital goods manufacturing economies with relatively sizable exports to China (in percent of own GDP) and are highly integrated with the rest of the G20 such as Germany and Japan. For economies that rely less on China's demand, such as the UK and India, the spillover effects on industrial production and aggregate output are moderate. Important commodities exporters, such as Canada and Brazil, would experience non-negligible spillover effects on export growth which would translate into somewhat significant output loss and slowdown in overall economic activity. Worsened global growth prospects would be reflected in asset prices and sovereign bond spreads (except the US for the latter, which points to its safe haven status). One year after the shock, commodity prices, especially metal prices, could fall by as much as 0.8–2.2 percent from baseline levels for every 1 percent drop in China's FAI.

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Appendix A: Contributions to Growth from Exports to China, Select Economies

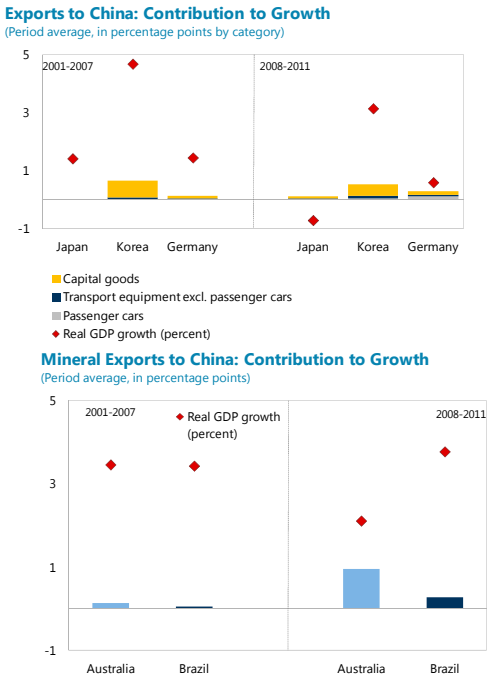
Summary Statistics, 2002-11

	Mean	Std Dev	Min	Max
	y/y percent change			
China fixed investment	13.5	3.7	9.7	23.5
China manufacturing fixed investment	16.6	2.9	11.0	20.6
China nontradables fixed investment	11.4	6.2	5.6	26.8
	Exports to China / GDP, percent			
Australia	2.4	1.4	1.1	5.0
Brazil	1.0	0.4	0.5	1.8
Chile	4.7	2.2	1.8	8.0
Germany	1.3	0.4	0.7	2.0
Japan	2.1	0.6	1.0	2.8
Korea	8.3	2.6	4.1	12.0
Malaysia	8.6	3.2	5.2	16.6
Taiwan Province of China	12.9	4.9	3.3	18.0
United States	0.4	0.2	0.2	0.7

Sources: DOTS; WEO.

A direct accounting approach for key, large economies shows that the contribution to growth from exports to China has increased appreciably during the global financial crisis period.

1. **A decomposition of exports by product type** for large capital goods exporters and commodity producers shows that the contribution to growth generated by exports to China has increased sharply during the period of the financial crisis and the stimulus response in China.



2. **In contrast to the cross-country regression above**, this calculation is a straight bilateral accounting exercise and does not provide a causal effect of specific spillovers from China's investment activity. It does, however, confirm the result from the cross-country exercise of the growing influence of China on trading partner growth. The calculation also shows that despite accounts of the rise of luxury goods exports (such as high-end passenger cars) to China from Japan and Germany, the fraction of growth they account for in these source economies is still relatively small. Finally, with regard to large commodity exporters, the contribution to growth from mineral exports to China has

more than doubled during the 2008–11 period compared to 2001–07. In Australia's case, they accounted for just below one-half of growth in the later interval. With regard to Brazil, the accounting exercise confirms that the economy appears well diversified and exports to China account for a relatively small fraction of overall growth even during the period of infrastructure expansion in China.

Regression Results

Baseline Estimates, Entire WTO Period: Controlling for Country Fixed Effects

Table 1. Entire WTO Period 2002-11; Fixed Effects

	Total Investment (1)	Manufacturing (2)	Nontradables (3)
China spillover effect	0.0128*** (0.00418)	0.0381*** (0.0106)	0.0255*** (0.00561)
Terms of trade	9.69e-06*** (1.85e-06)	0.000589 (0.00303)	0.000260 (0.00306)
Volatility of growth	-0.424 (0.271)	-0.771*** (0.231)	-0.854*** (0.247)
SAMPLE YEARS	2002-2011	2002-2011	2002-2011
Number of countries	64	64	64
Observations	640	448	448
R-squared	0.03	0.13	0.14

Notes: Dependent variable: Real GDP Growth, y/y percent change. Fixed Effects Estimation.
Robust Standard Errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Effect is even stronger in recent years…

Table 2. Global Crisis and Stimulus Period, 2008-11; Fixed Effects

	Total Investment (1)	Manufacturing (2)	Nontradables (3)
China spillover effect	0.0741***	0.0901***	0.0561***
	(0.0105)	(0.0201)	(0.00747)
Terms of trade	-0.00414	-0.00159	-0.00393
	(0.00433)	(0.00428)	(0.00433)
Volatility of growth	-0.828***	-0.566***	-0.897***
	(0.146)	(0.184)	(0.141)
SAMPLE YEARS	2008-2011	2008-2011	2008-2011
Number of countries	64	64	64
Observations	256	256	256
R-squared	0.2	0.14	0.21

Notes: Dependent variable: Real GDP Growth, y/y percent change. Fixed Effects Estimation.
Robust Standard Errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Results are robust to changes in estimation technique (Panel GMM) and inclusion of lagged growth

Table 3. Entire WTO period, 2002-11; GMM

	Total Investment (1)	Manufacturing (2)	Nontradables (3)
Lagged GDP growth	0.230***	-0.127	-0.0751
	(0.0527)	(0.0886)	(0.0950)
China spillover effect	0.0332***	0.0457***	0.0367***
	(0.00840)	(0.0132)	(0.00718)
Terms of trade	-2.50e-06	-1.91e-06	-0.000655
	(1.27e-05)	(0.00321)	(0.00332)
Volatility of growth	-0.299	-1.312***	-1.407***
	(0.278)	(0.289)	(0.263)
SAMPLE YEARS	2002-2011	2002-2011	2002-2011
Number of countries	64	64	64
Observations	640	384	384
Arellano Bond test of no second order autocorrelation in first-differenced errors (p-value)	0.22	0.08	0.15

Notes: Dependent variable: Real GDP Growth, y/y percent change. Panel GMM estimation.
Robust Standard Errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Pattern of stronger effects during the 2008-2011 period is replicated in the GMM setting

Table 4. Global Crisis and Stimulus Period, 2008-11; GMM

	Total Investment (1)	Manufacturing (2)	Nontradables (3)
Lagged GDP growth	-0.130	-0.241**	-0.122
	(0.139)	(0.113)	(0.139)
China spillover effect	0.0543***	0.0511***	0.0434***
	(0.0103)	(0.0116)	(0.00797)
Terms of trade	-0.00685	-0.00632	-0.00684
	(0.00430)	(0.00394)	(0.00424)
Volatility of growth	-1.973***	-2.006***	-2.001***
	(0.423)	(0.378)	(0.416)
SAMPLE YEARS	2008-2011	2008-2011	2008-2011
Number of countries	64	64	64
Observations	256	256	256
Arellano Bond test of no second order autocorrelation in first-differenced errors (p-value)	0.11	0.28	0.12

Notes: Dependent variable: Real GDP Growth, y/y percent change. Panel GMM estimation.
Robust Standard Errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

China's nontradables investment has a spillover impact beyond the effect of global growth

Table 5. Robustness Check for Global Crisis and Stimulus Period, 2008-11; GMM

	Total Investment (1)	Manufacturing (2)	Nontradables (3)
Lagged GDP growth	-0.0805	-0.0412	-0.0772
	(0.0803)	(0.0949)	(0.0809)
China spillover effect	0.0250***	0.00889	0.0211***
	(0.00815)	(0.00973)	(0.00608)
Terms of trade	-0.000646	-0.00199	-0.000725
	(0.00297)	(0.00280)	(0.00297)
Volatility of growth	-1.363***	-1.119***	-1.388***
	(0.276)	(0.332)	(0.274)
World growth ex China	0.696***	0.875***	0.684***
	(0.0920)	(0.109)	(0.0916)
SAMPLE YEARS	2008-2011	2008-2011	2008-2011
Number of countries	64	64	64
Observations	256	256	256
Arellano Bond test of no second order autocorrelation in first-differenced errors (p-value)	0.43	0.05	0.49

Notes: Dependent variable: Real GDP Growth, y/y percent change. Panel GMM estimation.
Robust Standard Errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

China's consumption growth has an insignificant spillover impact on trading partner growth

Table 6. Spillover Effects From China Consumption Growth

	(1)	(2)
Lagged GDP growth	0.198***	-0.240*
	(0.0541)	(0.131)
China spillover effect (consumption)	-0.0110	-0.0319
	(0.0145)	(0.0362)
Terms of trade	5.13e-06	-0.00472
	(1.49e-05)	(0.00427)
Volatility of growth	-0.345	-2.059***
	(0.285)	(0.430)
SAMPLE YEARS	2002-2011	2008-2011
Number of countries	64	64
Observations	640	256
Arellano Bond test of no second order autocorrelation in first-differenced errors (p-value)	0.77	0.45

Notes: Dependent variable: Real GDP Growth, y/y percent change. Panel GMM estimation. Robust Standard Errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Appendix B

Table 1. Impacts one year after a 1-percent exogenous decline in China's real total FAI: Economic Activity Indicators

(in percent below baseline level)

World Indicators:	Industrial Production	Real GDP
Argentina	0.54	0.11
Australia*	0.02	0.00
Brazil	0.25	0.05
Canada**	n.a.	0.06
China	0.12	0.10
France	0.17	0.02
Germany	0.61	0.11
India	0.28	0.05
Indonesia*	0.15	0.05
Italy	0.46	0.08
Japan	0.55	0.12
Mexico	0.34	0.09
Russian Federation	0.25	0.05
Saudi Arabia	0.09	0.02
South Africa	0.30	0.05
Korea	0.14	0.04
Turkey	0.45	0.09
UK	0.13	0.02
US	0.21	0.03
EU	0.19	0.03
PPP-weighted average		0.06

Remark: A one-standard-deviation decline in growth is equivalent to 2.5-percent decline in real estate investment levels from baseline

* Estimates for Australia and Indonesia are not statistically significant.

** Canada's economic activity is represented by monthly real GDP index, all

Table 2. Impacts one year after a 1-percent exogenous decline in China's real total FAI: Selected Commodity Prices

(in percent below baseline level)

World Prices:	(In percent, year-on-year)
Metals	1.3
Non-fuel primary commodities	0.7
Zinc	2.2
Nickel	1.8
Lead	1.8
Copper	1.6
Iron ore	0.8
Aluminum	1.0
Rubber	0.6
Silver	0.6
Gold	0.2

Remark: A one-standard-deviation decline in growth is equivalent to 2.5-percent decline in real estate investment levels from baseline

Table 3. Impacts one year after a 1-percent exogenous decline in China's real total FAI: Trade indicators

(in percent below baseline level)

Trade Indicators:	Import Value	Export Value
Argentina	2.24	0.35
Australia	0.75	0.13
Brazil	0.98	0.58
Canada	0.91	0.87
China	0.74	0.74
France	0.69	0.85
Germany	0.74	0.85
India	0.42	0.79
Indonesia	0.48	0.77
Italy	1.01	1.15
Japan	0.87	0.66
Mexico	0.90	0.94
Russian Federation	0.85	0.56
Saudi Arabia	0.44	0.95
South Africa	0.68	0.14
Korea	0.65	0.74
Turkey	0.93	0.52
UK	0.93	0.90
US	0.92	0.58
EU	0.83	0.90
Weighted average	0.82*	0.76**

Remark: A one-standard-deviation decline in growth is equivalent to 2.5-percent decline in total FAI levels from baseline

*Import-weighted. ** Export-weighted.

Table 4. Impact on metal prices from China's investment drive during 2008-11.

	Model's implied difference from counterfactual, in percent (A)	Actual change, in percent (B)	Counterfactual change (without China's investment drive), in percent (B-A)
Zinc	75.1	16.5	-58.6
Nickel	60.6	8.4	-52.2
Lead	59.3	14.7	-44.7
Copper	52.6	26.7	-25.9
Aluminum	33.4	-6.9	-40.3
Iron Ore	24.3	172.6	148.3
Silver	20.3	135.1	114.8
Rubber	18.4	84.3	65.9
Gold	4.0	79.9	75.9

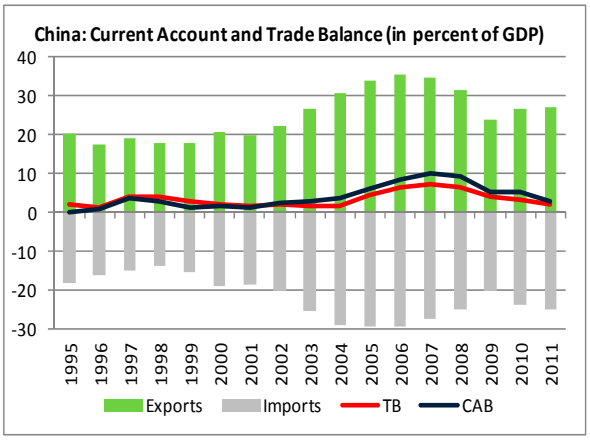
Remark: The counterfactual scenario assumes China's investment-to-GDP ratio is maintained at end-2007 level during 2008-11, which translates to 34.4 percent lower FAI than actual level.

14. China's Trade Balance Adjustment: Spillover Effects[1]

The recent decline in the current account surplus was driven mainly by an increase in imports, especially of commodities and capital goods. Preliminary evidence suggests an important contribution of China's import demand on exports and growth in Japan and Korea, and a smaller but growing contribution in Germany.

Trends in China's Trade Balance

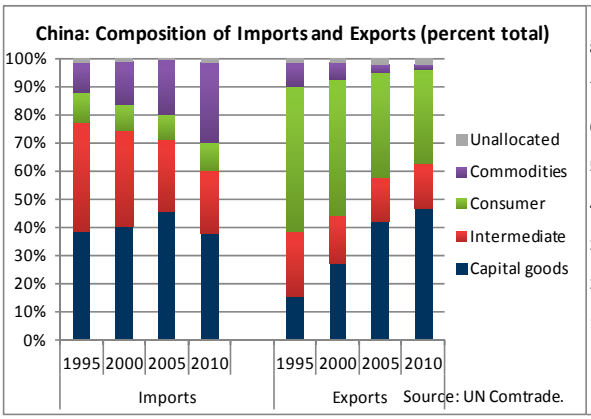
1. **Is China rebalancing**? China's current account surplus declined from a peak of 10.1 percent of GDP in 2007 to 2.9 percent in 2011. This in large part reflects a narrowing trade surplus, as imports have continued to grow strongly, more than offsetting a gradual recovery in exports since 2009. These trends have raised prospects of a possible economic rebalancing in China (see IMF, *Asia: Regional Economic Outlook,* April 2012), although the extent to which this is being driven by cyclical or structural factors is not yet clear.

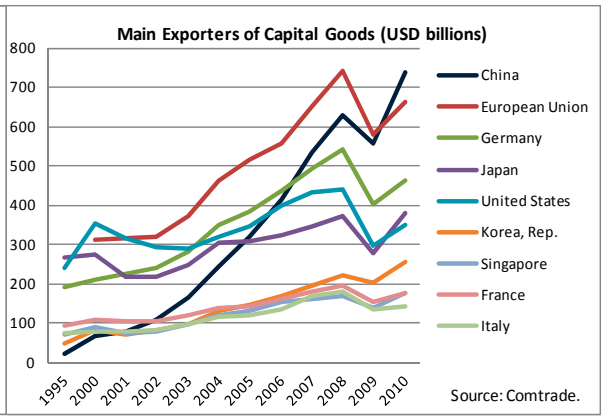


2. **Patterns in external trade**. The share of commodities in China's imports has been rising, especially since 2005, while the share of capital goods has remained relatively stable at about 40 percent of total imports.[2] The surge in imports of commodities, especially minerals, was tied to the infrastructure build-out during the 2008–09 stimulus package. The persistent strength in imports of capital goods also reflects high and rising investment spending, such as capacity building in new growth industries and export sectors (see IMF, *Asia: Regional Economic Outlook,* April 2012). Indeed, on the export side, the share of capital goods has risen substantially over the past decade, accounting for almost half of total exports in 2010. In 2010, China overtook Germany and the entire European Union as the main exporter of capital goods to the world.

[1] Prepared by Irena Asmundson, Nagwa Riad, and Mika Saito (SPR).

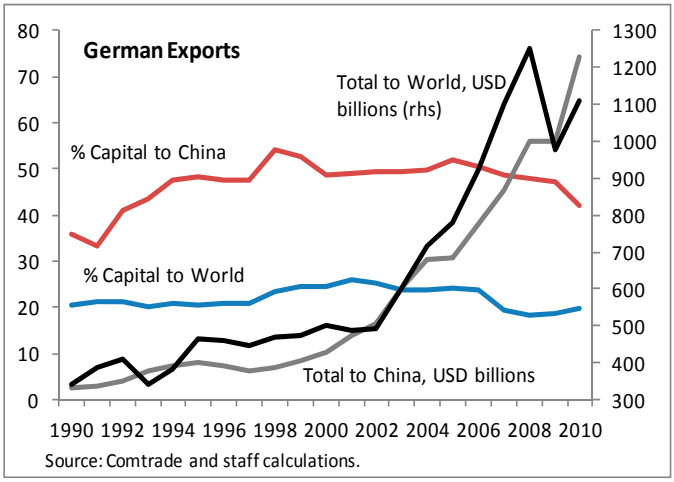
[2] Capital goods are defined according to the Broad Economic Categories classification to include SITC codes 41 and 42 (capital goods except transport equipment) and codes 521 and 53 (transport equipment).



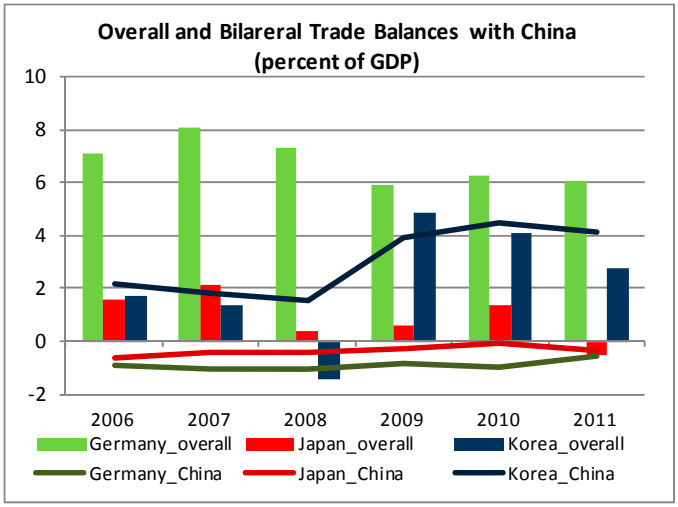


Who Benefits from China's Investment Drive?

3. **Capital goods exporters**. The capital intensity of China's investment drive is likely to positively impact exports and growth of key capital goods producers, such as Germany, Japan, and Korea, with possible spillover effects on supplier countries. In fact, capital goods comprise almost half of German exports to China (more than double the share in world exports). Thus, if China's increased demand for capital goods leads to higher exports (and therefore growth) in Germany, this could have a beneficial second round effect on other countries in Europe that are part of the supply chain. The same would be true for the supply chain countries around Japan and Korea.

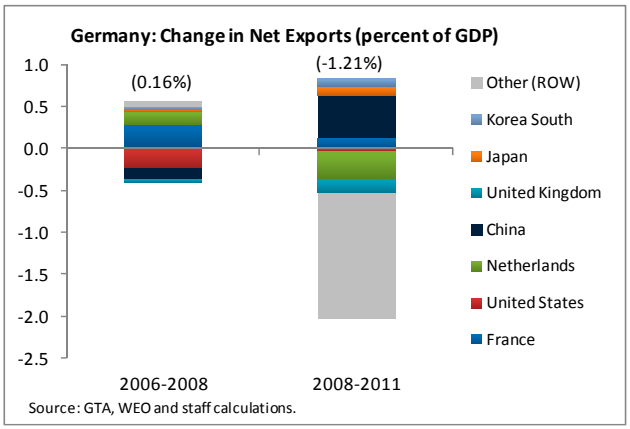


4. **Bilateral trade balances.** Despite having a surplus on the trade balance overall throughout the period (except in 2008 for Korea and 2011 for Japan), only Korea has a bilateral trade surplus with China. In Germany, the bilateral trade deficit with China was halved in 2011 compared to 2008 (from 1.1 percent to 0.5 percent of GDP), as exports grew at a faster pace than imports, whereas in Japan the bilateral deficit was relatively unchanged over the same period.

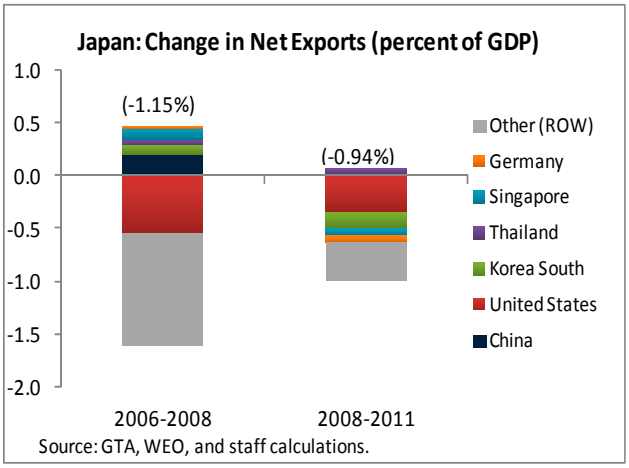


5. **Contribution to net export growth**. Overall, the results based on aggregate trade data suggest that China's contribution to export growth is important in Japan and Korea, and is growing for Germany (see Box 1 for details). China's role in supporting export growth increased significantly after the crisis, more than offsetting the negative drag from reduced demand in advanced economies in Germany and Korea, and to a different extent in Japan.

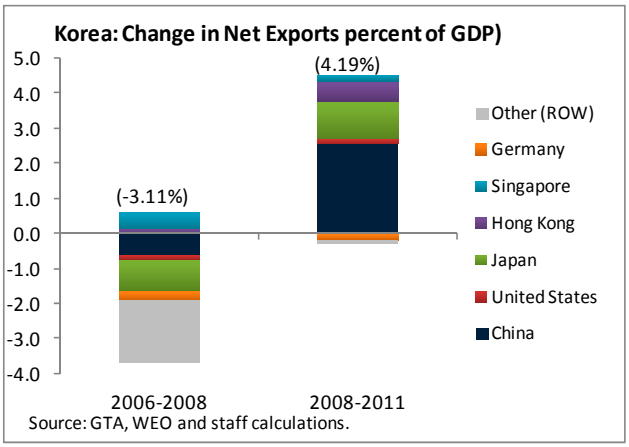
- ***Germany***. China's contribution to export growth in Germany increased significantly after the crisis. Between 2006 and 2008, net exports as a percent of GDP increased by 0.16 percent, of which China's contribution was negative (0.13 percent), reflecting Germany's bilateral trade deficit. However, between 2008 and 2011, even though net exports overall as a share of GDP *contracted* by 1.2 percent, China's contribution was a *positive* 0.51 percent—the largest contributor to export growth—reflecting the lower drag from a narrowing deficit (as discussed above) and partly offsetting the reduced demand in other countries.



- ***Japan***. China's import demand is even more important for Japan's export growth. During 2006–2008, even though net exports as a share of GDP contracted by close to 1.2 percent, China's contribution was positive, along with other supply chain countries such as Korea and Singapore, but not enough to offset the negative drag from reduced global demand in 2008. Over the same period, exports as a share of GDP grew by 1.2 percent, with China contributing almost a third (0.44 percent); from 2008 to 2011, exports *contracted* by 1.96 percent of GDP, with China contributing a positive 0.21 percent—the only country along with Thailand with a positive contribution though not nearly enough to offset the negative drag from other advanced economies such as the United States.



- ***Korea***. The contribution of China's import demand in Korea's net exports growth is much larger in the recent period. Between 2006–2008, net exports as a share of GDP contracted by more than 3 percent, as Korea registered an overall trade deficit in 2008 (see chart in paragraph 4 above), with China contributing negatively. More recently, net exports increased by 4.2 percent of GDP, of which China contributed more than half (2.6 percent).

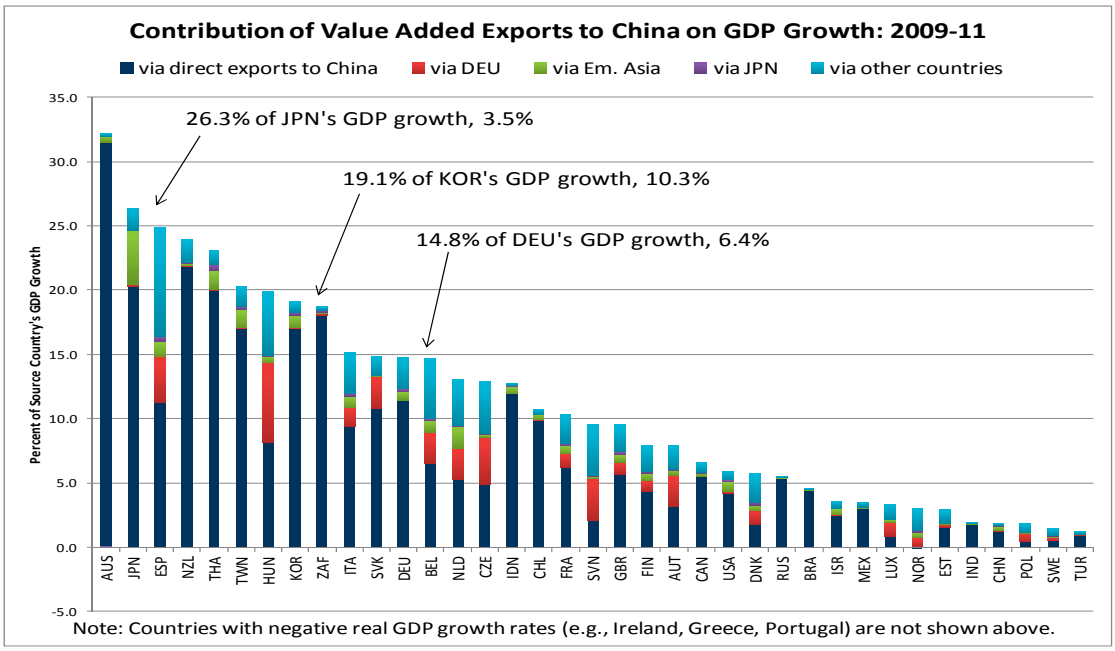


Source: GTA, WEO and staff calculations.

6. **Contribution to GDP growth**. Value-added trade can be used to compute both the direct effect and the indirect effect through the supply chain of China's import demand. This analysis also confirms a larger impact of China's import demand on growth in supply chain countries.

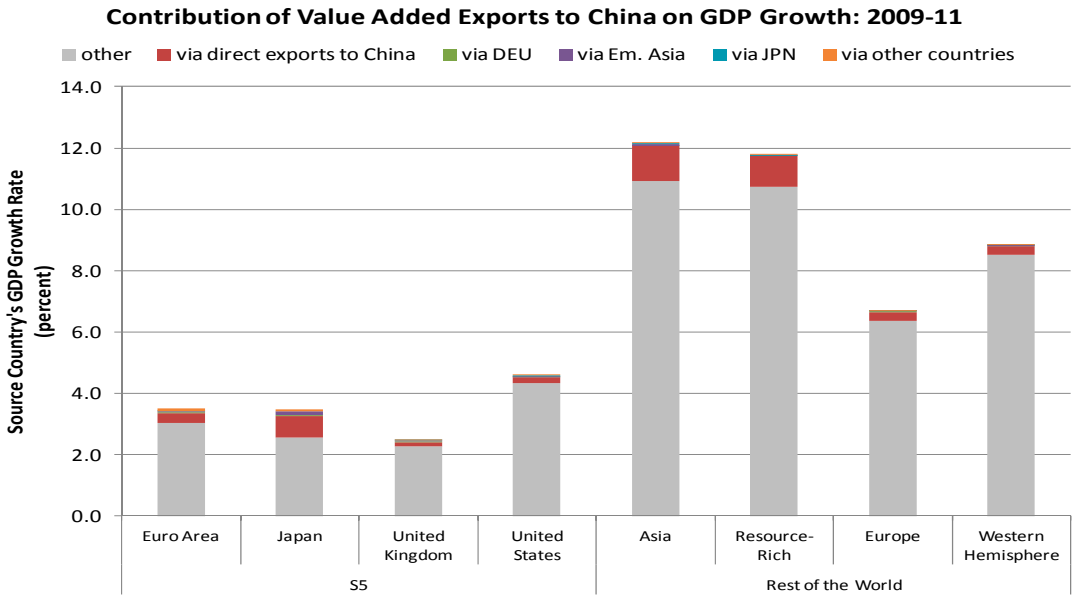
- ***Methodology***. To compute the direct and indirect effect through the supply chain, Chinese bilateral gross imports, say from Germany, are first decomposed into Germany's domestic value added and Germany's imported contents using input-output tables and Germany's bilateral trade data. These imported contents, say from the Czech Republic, are then further decomposed into the Czech Republic's value added and the Czech Republic's import contents; beyond this, it is assumed to comprise foreign value added only. The value added exports to China are then aggregated by source countries. Gross trade data should match exactly value added trade data, unless input-output information is missing. To obtain the real growth rate of value added exports from 2009 to 2011, the value added exports for 2011 are deflated by the GDP deflator computed using real and nominal GDP in US dollars.

- ***Capital good exporters***. More than a quarter of Japanese growth between 2009 and 2011 is attributed to Chinese import demand (0.9 percent of 3.5 percent), and fifth of Korea's growth (almost 2 percent of 10.3 percent). China's contribution to German growth is smaller, accounting for about one-sixth of GDP growth during 2009–11 (0.95 percent of 6.4 percent). Korea's exposure to China is almost entirely through direct exports, whereas Japan is additionally exposed through indirect exports via supply chain countries, reflecting its upstream role in the Asian supply chain.



Note: Countries with negative real GDP growth rates (e.g., Ireland, Greece, Portugal) are not shown above.

- ***Supply chain and commodities***. Supply chain partners and commodity exporters are equally exposed to China's import demand (the latter are Australia, Brazil, Chile, and South Africa, since more than 90 percent of their exports to China are agriculture, mining or basic metal products). China's contribution to growth was about one-tenth in Asia (1.3 percent of 12.2 percent) and the commodity exporters (1.1 percent of 11.8 percent), almost entirely through direct exports. A deceleration in China's import demand is therefore likely to adversely impact growth in both Asian countries and commodity exporters, including through lower global commodity prices.

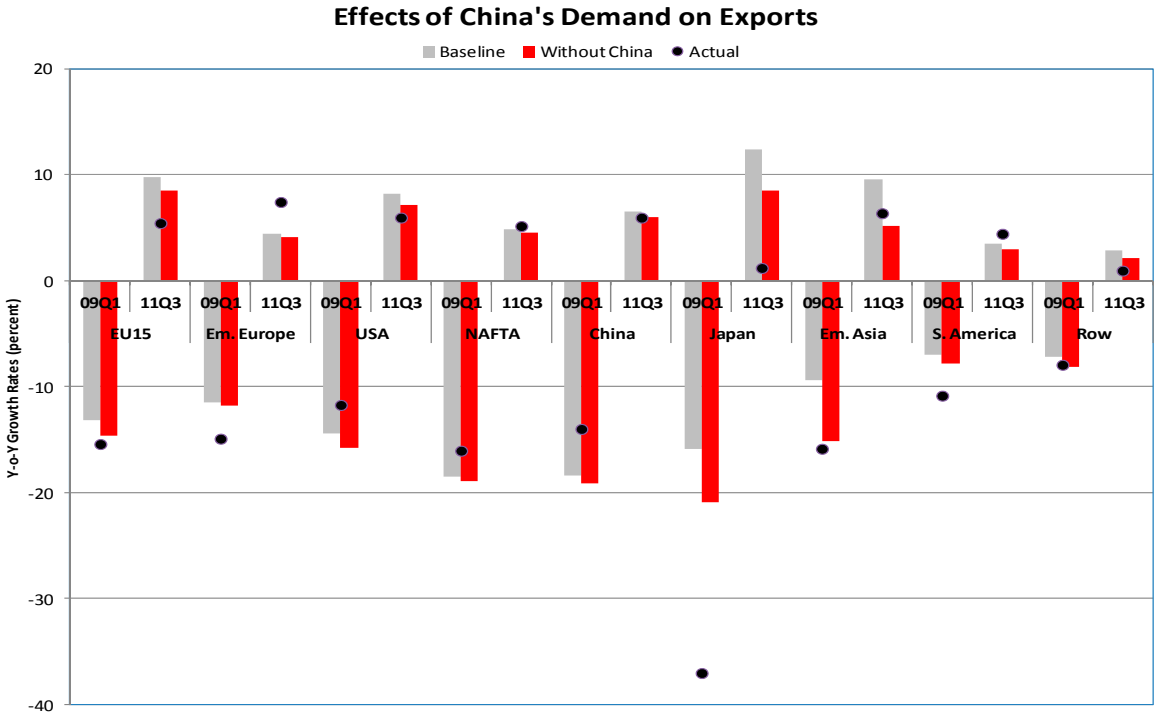


Source: OECD Input-Output Database, OECD Bilateral Trade Database, WEO, Staff estimates.

7. **A counterfactual**. One way to pin down the impact of China's investment drive is to simulate exports of capital goods producers with and without China's demand for durables.

- A simple general equilibrium model is used featuring input-output linkages, three sectors (durables, non-durables and services), and nine countries/regions.[3] The model is estimated for two periods: 2009:Q1 and 2011:Q3 to account for (y-o-y) changes in the rate of growth of investment. In the former period, the investment drive outpaced GDP growth (28 percent and 7 percent respectively), whereas, in the latter period, it is largely in line with GDP (9 percent and 10 percent, respectively).

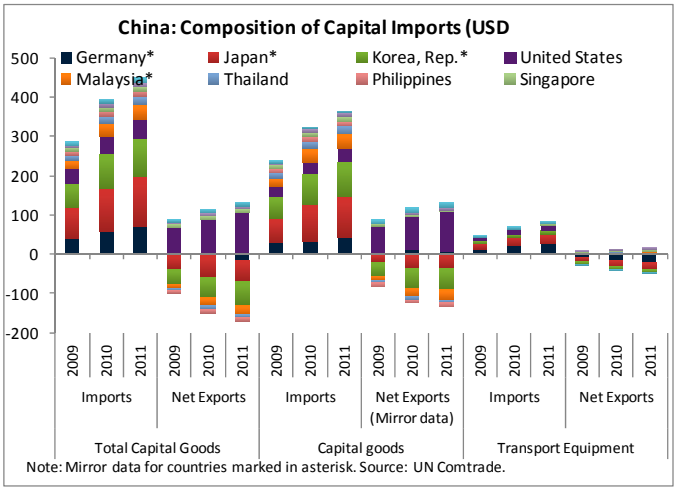
- In the absence of China's demand, the growth rates of exports could potentially be reduced by 5–6 percentage points for Japan and emerging Asia, and 1–2 percentage points for EU-15 and the United States. The model replicates well the growth rates of exports in some countries for some periods but not for others. For instance, model predictions are far from actual for Japan and emerging Europe in both periods. However, the model predicts that demand from China can make a difference to the rest of the world, especially Asia and, to a lesser extent, Europe.

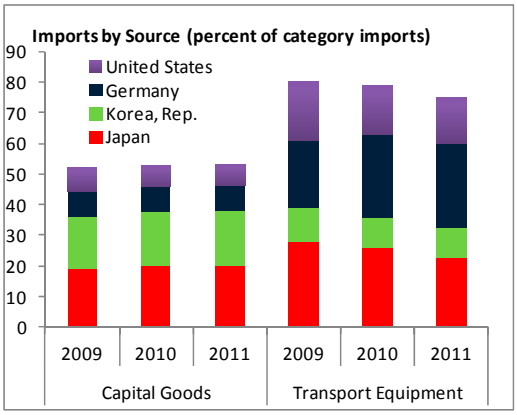


[3] The model is set up to replicate actual domestic demand figures from IMF Global Data Source. Domestic demand is assumed to be driven entirely by the demand for durable goods (both investment and consumption)—this assumption generates the largest effects on trade spillovers along global supply chains.

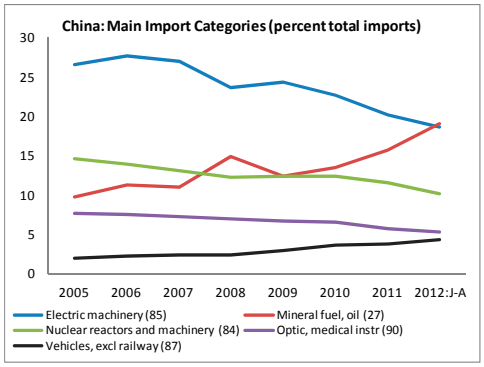
Box 1: German Exports to China—Is It Just Autos?

Definition. Based on the Broad Economic Classification (BEC), capital goods include capital products under SITC codes 41 and 42 (capital goods excluding transport equipment) and transport equipment (SITC codes 521 and 53). Overall, China is a net importer of capital from Japan, Korea, and more recently, Germany. Whereas import shares have been relatively stable for capital goods, Germany's share of Chinese vehicle imports has increased steadily since 2009, at the expense of a declining share of imports from Japan and the United States.

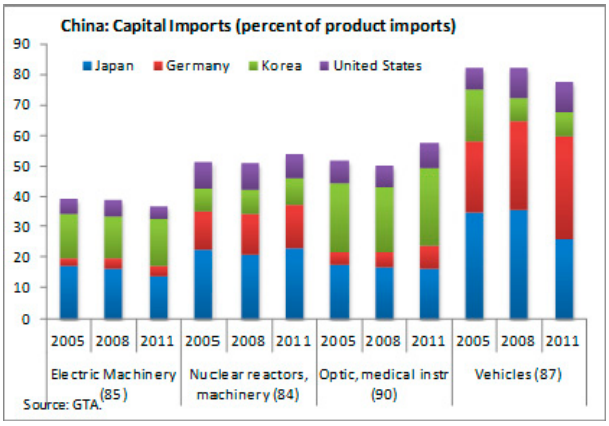




Main import categories. Despite the significant rise in exports of vehicles to China, German exports of other capital goods have also increased. Although not a direct mapping with BEC classification used above, a closer look at aggregate trade data based on HS1988/92 nomenclature can help shed further light on underlying changes in export patterns. BEC classification of capital goods broadly maps into the following HS categories: nuclear reactors and machinery (84), electric machinery (85), optic and medical instruments (90), and vehicles excpet railways (87). China's imports of these four products have declined from 50 percent in 2005 to about 41 percent in 2011, in large part due to lower imports of electric machinery and, to a lesser extent, nuclear reactors and machinery.



Imports from Germany. German exports of cars now account for a much larger share of total car imports by China (from 23 percent to 34 percent), largely displacing imports from Japan and Korea. However, import shares from Germany have also increased for optica and medical instruments (doubled over the period, albeit from a small base) and for nuclear reactors and machinery (despite an overall declining share for this import category). German share of electric machinery imports (85) is very limited small, as the most important suppliers are supply chain countries within the region, inlduing Japan and Korea. Overall, Germany's share of total Chinese imports of these four categories has almost doubled over the period, from 6 percent in 2005 to about 10 percent in 2011.

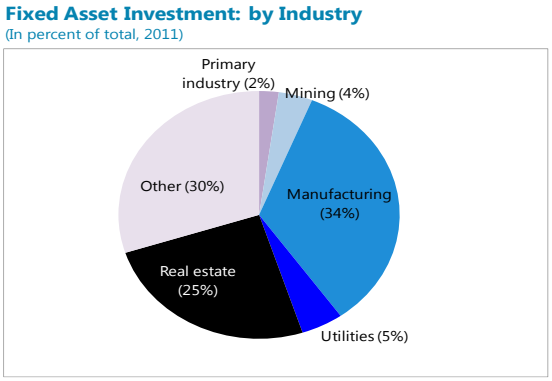


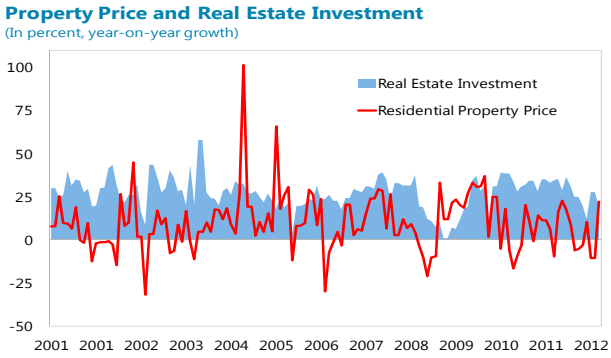
15. The Spillover Effects of a Downturn in Real Estate Investment [1]

Real estate investment accounts for a quarter of total fixed asset investment (FAI) in China. The impact on economic activity of a collapse in real estate investment in China, a low-probability event, is sizable, with large spillovers to a number of China's trading partners. A 1-percent decline in China's real estate investment would shave about 0.1 percent off China's real GDP within the first year, with negative spillover impacts on China's G20 trading partners causing global output to decline by roughly 0.06 percent from baseline. Japan, Korea, and Germany would be among the hardest hit. In that event, commodity prices, especially metal prices, could be as much as 0.8-2.2 percent below baseline one year after the shock.

Recent Trends and Risks

1. **The relatively new private property market in China has been susceptible to excessive price growth, requiring escalated intervention by the authorities over the years**. The underlying structural features of the economy, namely low real interest rates in a high growth environment, the under-developed financial system (offering few alternative assets) and a closed capital account, foster overinvestment in real estate and create a propensity for bubbles in the property market, posing risks to market sustainability and financial stability. Currently, real estate investment accounts for one quarter of China's fixed asset investment. It has grown at around 31½ percent per annum over the past two years (2010–2011)



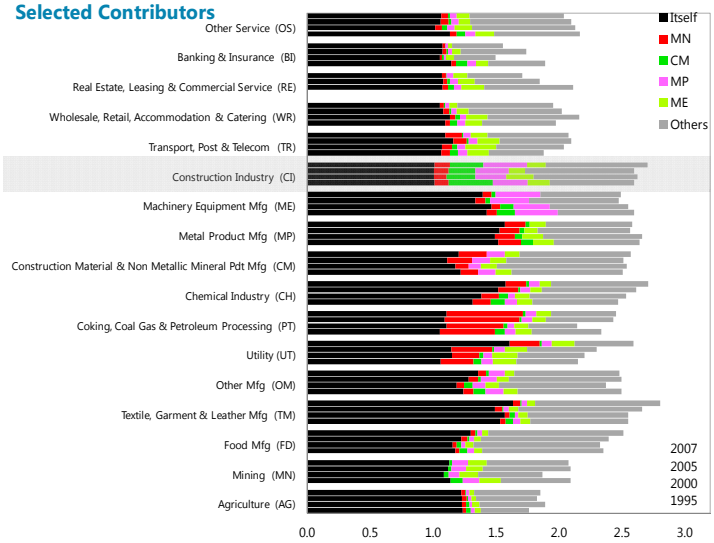


2. **Policy response relies largely on quantity-based tools, the effectiveness of which tends to erode over time as more transactions are intermediated outside of the banking system, requiring more potent policy responses**. In the most recent episode of property boom, which started around mid-2009, the authorities escalated their response with restrictions on second and third home purchases in larger cities and credit limits on property developers. Thus far, the authorities appear to have succeeded in curbing market exuberance while maintaining robust

[1] Prepared by Ashvin Ahuja and Alla Myrvoda, (APD) with useful comments from Steven Barnett, Il Houng Lee, Andre Meier, Malhar Nabar, and Papa N'Diaye.

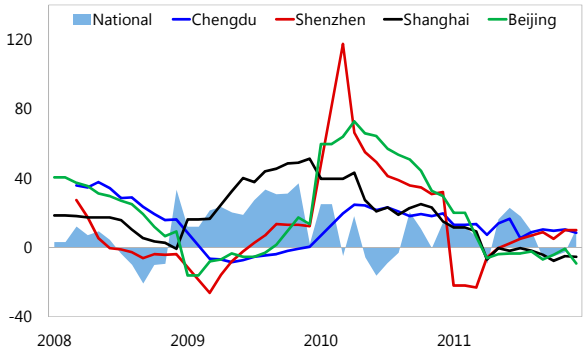
investment growth, chiefly through an expansion of social housing programs and a selective easing of financial conditions for first-time home buyers. Nevertheless, developers' financial conditions are deteriorating, and there is a risk that policy over-tightening could turn near-term price expectations decidedly negative as high inventory-to-sale ratios compress developers' profitability further, leading to a collapse in real estate investment.

Backward Linkages: Selected Contributors



3. **The risk to growth and financial stability of a collapse in real estate investment is high**, based on the expected economic repercussions should the event come to pass. Based on China's input-output information, the real-estate dependent construction industry—which accounts for 7 percent of GDP—creates significant final demand in other domestic sectors (i.e. it has among the highest degrees of backward linkages), particularly to mining, manufacturing of construction material, metal and mineral products, machinery and equipment, as well as real estate services. As a result, a decline in real estate investment has the potential to disrupt the production chain throughout China's economy, and with that potential spillovers to G20 trading partners.

Property Prices
(In percent, year-on-year growth)



Source: CEIC; Soufun; and IMF staff calculations.

Modeling the Spillover Effects

4. **A factor-augmented VAR (FAVAR) approach is used to gauge the domestic and global spillovers of a slowdown in China's real estate investment in an event of a sharp property market correction**. The FAVAR framework was introduced by Bernanke, Boivin and Eliasz (2005) and extended by Boivin and Giannoni (2008) into a two-region model that allows China to interact with the rest of the world (represented here by the other G20 economies). The analysis captures the feedback from China to the rest of the world, and vice versa, over time. It also captures the spillover effect between the other G20 economies from a specific event originating in China.

5. **Market participants monitor hundreds of economic variables in their decision making process, suggesting the need to employ models that draw on a rich information set.** The FAVAR framework extracts information from a rich data set to gauge the impact of particular forces that may not be directly observable. These "forces" are treated as latent common components, which are inter-related, and their impacts are traced through impulse response functions. Accounting for unobserved variables reduces the likelihood of spurious associations.

6. **The model and estimation strategy are detailed in the appendix**. In brief, the model is a stable FAVAR specified in growth terms (except for balances and interest rates) with 5 common factors for each region and China's real estate investment. The model uses one lag. The Cholesky factor from the residual covariance matrix is used to orthogonalize the impulses, which imposes an ordering of the variables in the VAR and treats real estate investment as exogenous in the period of shock. The results are robust to re-ordering within factor groups. The data set is a balanced panel of 390 monthly time series from the G20 covering 2000M1—2011M9, with 68 variables foe China and 322 for the rest of the world. The sample contains at least one full cycle of real estate investment and the property market in China. It covers the period when China entered the WTO and became increasingly integrated with the world economy.

Data	China (68 variables)	G20 ex-CHN (322 variables)
Real Economy	IP, Gross VA, Investment, Consumption, Floor space, Land area purchased/developed	IP
Labor	Urban employment	Employment (total/ non-farm)
Financial	M2, Credit, short-term interest rates, Shanghai Composite, USD/RMB	M2, credit, short-term interest rates, Treasury bond spreads, Stock Market Indices, USD/NC
Trade	Exports (components), Imports (components), trade balance	Exports, Exports to China, Imports, Imports from China, Trade balance
Prices	CPI, PPI, House price, Commodity prices (local)	CPI, PPI, Terms of trade, Commodity prices

7. **The scenario assumes an exogenous, temporary, *one-standard-deviation* growth shock to China's real estate investment**. The shock dampens within a few months and dissipates fully after around 36 months. [2] While this is a temporary growth shock, real estate investment declines permanently in level terms by about 2-percent. No policy response is assumed beyond that already in the sample.

8. **Twenty-four-month peak impacts to a one-standard-deviation shock to real estate investment** are reported with standard error bands in the charts below. Impacts on levels 12-months after the shock, in percent below baseline, are also derived and reported in Tables 1–4.

[2] A one standard deviation shock is 3 percentage points in month-over-month, seasonally adjusted, growth rates. Specifically, this is a one-time 49-percentage-point (seasonally adjusted, annualized) drop in real estate investment growth that reverts to trend growth largely within 4–5 months.

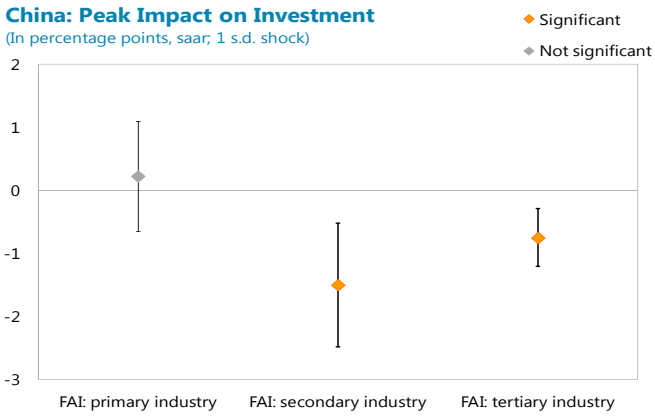
Domestic Feedback

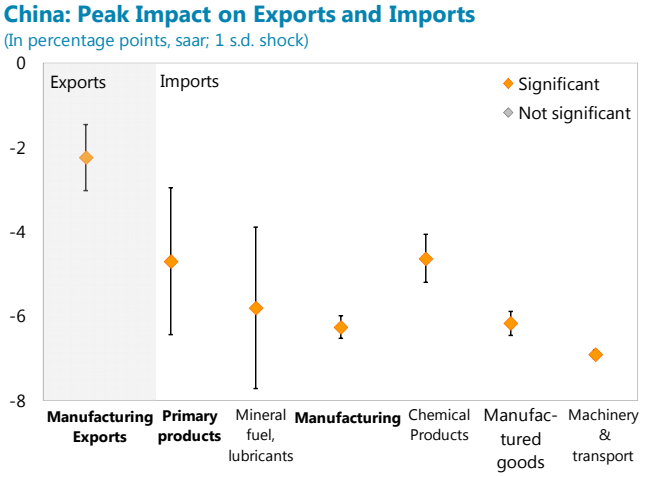
9. **A rapid growth slowdown in real estate investment would reverberate across the economy, lowering investment in a broad range of sectors** (Table 1) Given strong backward linkages to other industries, especially manufacturing of construction material, metal and mineral products, machinery and equipment, a temporary, one-standard-deviation decline in real estate investment growth would cause investment in manufacturing-heavy secondary industries to slow by about 1½ percentage points at peak (within the first year). The impact on primary industry investment growth, which contains mining, is unclear. Total FAI declines by about 0.8 percent 12 months after the shock.

Table 1. Impacts one year after a 1-percent exogenous decline in China's real estate investment: Selected China Indicators

China Indicators:	(In percent, year-on-year)
Gross value added, real	0.1
GDP, real	0.1
Retail sales, real	0.1
Exports	0.7
Imports	0.8
Total FAI	0.4
Residential property:	
Price	0.7
Floor space sold	1.5

Remark: A one-standard-deviation decline in growth is equivalent to 2-percent decline in real estate investment levels from baseline



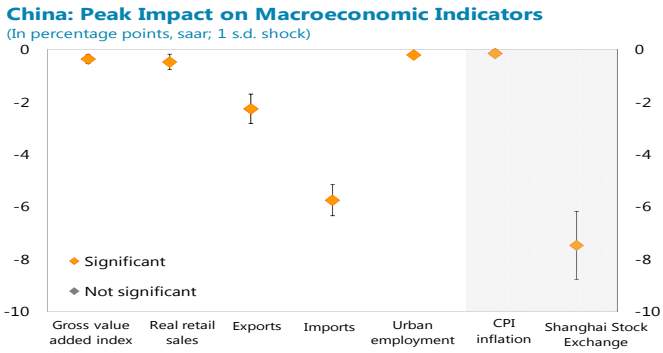


10. **Other components of demand respond in a consistent fashion**. Export growth, particularly manufacturing, falls by around 2¼ percentage points mainly due to lower demand by trading partners. Lower domestic demand and weaker export growth reduces import growth by about 5¾ percentage points at peak impact. Equivalently, export and import levels are about 1.4 and 1.6 percent lower, 12 months after the shock. The large fall in imports reflects the significant share of processing trade in total trade. The strong import responses reflect robust linkages of real estate activity to domestic industries that require inputs from abroad, namely manufacturing of construction material, mineral and metal products, as well as machinery and equipment.[3] China's REER as well as the RMB/USD exchange rate do not cushion

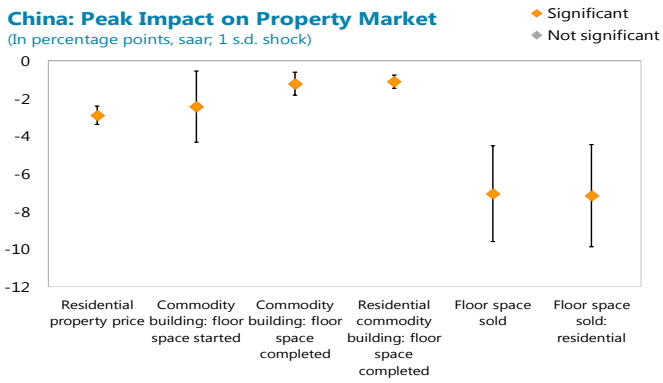
[3] The results are consistent with the input-output analysis, which identifies machinery and equipment manufacturing as well as mining as having the highest import coefficients, followed by the chemical industry.

exports in a meaningful way even though the rate of appreciation appears to slow slightly and lasts around 2–3 quarters.

11. **Consumption would be dampened as income and wealth expansion (including house price appreciation) slows**. Real retail sales dip by 0.2 percent below baseline 12 months after. Industrial gross value added growth would fall by around 0.4 percentage points at peak, consistent with about a 0.3 percentage points decline in real GDP on an annualized basis.[4] The impact would be felt almost immediately and would start to dissipate after 4 quarters. This would translate into a decline of about 0.3 and 0.2 percent below baseline levels for industrial value added and GDP, respectively, one year out.



12. **Worsened income and wealth would have important bearing on the overall and residential property markets**. As demand deteriorates, property market transactions volume and price growth drop—for example, residential transactions volume growth drops by around 7 percentage points at peak. One year out, residential real estate transactions volume would fall by 3 percent below baseline. House price growth, on the other hand, would be cushioned by dwindling current and future housing supply (from shrinking housing starts). Measured using official house price statistics, which are widely acknowledged to understate residential property price inflation, house price growth would decline by around 3 percentage points at peak, or 1.5 percent below baseline 12 months after impact. Meanwhile, the inflation in domestic prices of metal required for construction activity, such as aluminum, electrolyzed copper, and zinc would be lower by 1¼, 5, and 7⅓ percentage points, respectively. The deterioration in the property market has implications for financial institutions' balance sheets and financial stability. Nevertheless, without sufficient financial indicators at monthly frequency, the model cannot uncover the relationships between a property market slowdown and financial stability indicators.[5]



[4] A one-percentage-point decline in real industrial value added growth is consistent with about 0.8 percentage point decline in real GDP growth for China.

[5] Financial exposures to the property sector are likely larger than suggested by official data due to the increasing prominence of the shadow banking system and unobserved inter-corporate property related lending.

Global Spillover

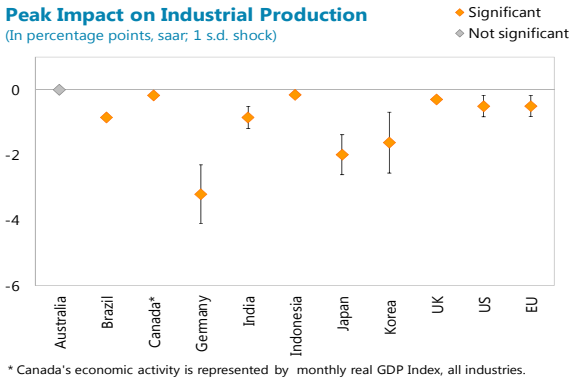
13. **A temporary shock to China's real estate investment growth would have spillover implications around the world, with the impacts on G20 economies lasting approximately 4–5 quarters**. In this scenario, the approximate impact on GDP growth would vary with the size of industrial production-to-GDP ratio in each economy. The implied peak impact on PPP-weighted G20 GDP growth is -0.2 percentage point, around 0.1 percent below baseline at 12 months after the shock (Table 2). Capital goods manufacturers that have sizable direct exposure to China and are highly integrated with the rest of the G20—therefore sharing adverse feedback from a negative shock in China with other trading partners—such as Germany, Japan, and Korea—would see more of the impact to industrial production and GDP. The results also show that global trade activity would decline (total exports and total imports for every G20 economy would weaken), which suggests that economies that derive significant benefit from global trade expansion and have deeper links via supply chain countries over the past decade, such as Germany and Japan, should be more hard hit in the second round (Table 3). The impact on Korea's GDP peaks within the first 2 quarters and fades away more quickly, which is consistent with the fact that Korea's direct exposure to China is large but second round effects through supply chain countries are smaller than Japan and Germany. For UK and India, exports to China would bear the brunt of the impact—machinery, equipment, and industrial supplies for the UK and mineral commodities and primary metal products for India—but the overall impact on economic activity would be relatively moderate.

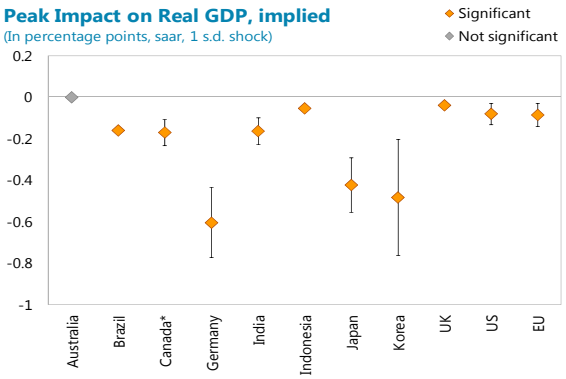
Table 2. Impacts one year after a 1-percent exogenous decline in China's real estate investment: Economic Activity Indicators

(In percent, year-on-year)

World Indicators:	Industrial Production	Real GDP
Argentina	0.52	0.10
Australia 1/	0.01	0.00
Brazil	0.28	0.05
Canada 2/	0.06	0.06
China 3/	0.12	0.10
France	0.15	0.02
Germany	0.64	0.12
India	0.27	0.05
Indonesia	0.02	0.01
Italy	0.47	0.08
Japan	0.50	0.11
Mexico	0.32	0.08
Russian Federation	0.23	0.05
Saudi Arabia	0.08	0.02
South Africa	0.29	0.04
Korea	0.19	0.06
Turkey	0.46	0.10
UK	0.08	0.01
US	0.20	0.03
EU	0.17	0.03
PPP-weighted average		0.06

Remark: A one-standard-deviation decline in growth is equivalent to 2-percent decline in real estate investment levels from baseline.
1/ Estimate for Australia is not statistically significant.
2/ Canada's economic activity is represented by monthly real GDP Index, all industries.
3/ China's industrial sector activity is represented by gross industrial value added.





14. **Commodities exporters to China, such as Australia and Brazil, would also experience non-negligible spillover effects on export growth**. Despite Australia's relatively large direct exposure to China, the AUD exchange rate works as a shock absorber and limits the impact on Australia's industrial production. Other indicators, such as employment growth and total import growth (not shown here), point to a slowdown in Australia's economic activity. Trade expansion with China and overall global trade would also slow as global and China demand growth weakens (Table 3). The impact on Indonesia's exports would likely come through China's coal demand. As coal exports to China have risen sharply over the past few years, the impact on Indonesia's output could be larger now than shown in Table 2.

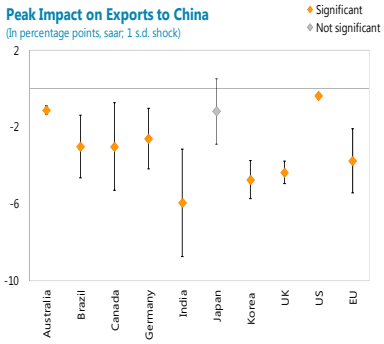
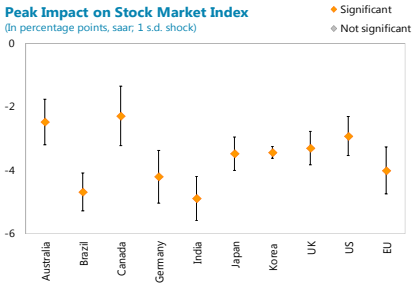


Table 3. Impacts one year after a 1-percent exogenous decline in China's real estate investment: Trade Indicators
(In percent, year-on-year)

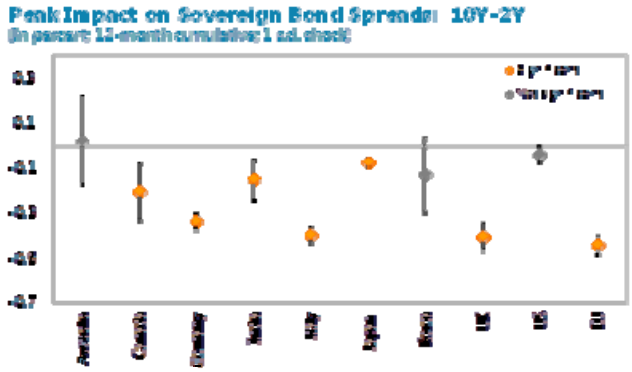
Trade Indicators:	Total Imports	Total Exports
Argentina	2.23	0.38
Australia	0.73	0.21
Brazil	0.97	0.69
Canada	0.90	0.85
China	0.78	0.68
France	0.75	0.88
Germany	0.74	0.81
India	0.51	0.95
Indonesia	0.00	0.82
Italy	0.98	1.02
Japan	0.83	0.64
Mexico	0.91	0.93
Russian Federation	0.81	0.73
Saudi Arabia	0.45	1.00
South Africa	0.84	0.20
Korea	0.65	0.78
Turkey	0.94	0.47
UK	0.92	0.94
US	0.90	0.61
EU	0.83	0.86
Weighted average	0.82*	0.76**

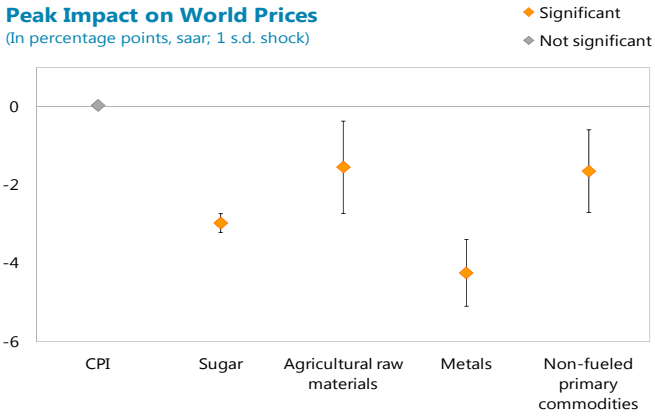
Remark: A one-standard-deviation decline in growth is equivalent to 2-percent decline in real estate investment levels from baseline.
*Import-weighted. ** Export-weighted.

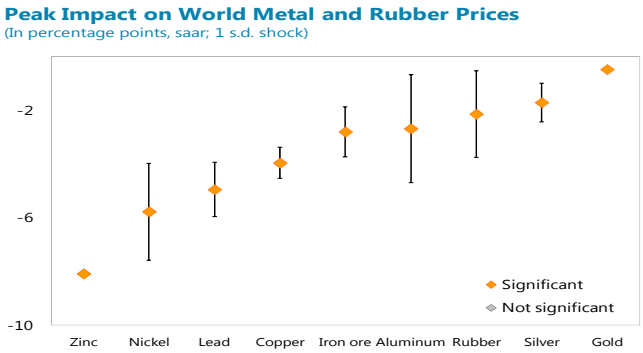
15. **The growth spillover effects are reflected in asset prices and valuation as well**. Stock market indexes in G20 economies would see tangible declines—with the largest impacts in Brazil, Germany, and India—and would remain for as long as 4–5 quarters. Related to this, a general decline in sovereign bond spreads (cumulative over the first 12 months after impact) seems to signal concerns about future global growth, complementing the immediate impacts on industrial production shown earlier. For the US, an initial flattening of the yield curve is reversed around 2 quarters after the shock, consistent with the US's special status as the ultimate safe haven destination for financial investment. The relatively large impact on Australia's asset prices reflects the strong economic linkages.



16. **The impact on global inflation appears modest**. Global growth slowdown and a drop in China's demand for base metal imports, initiated by a China real estate investment decline, could lead to a drop in iron ore, aluminum, copper, lead, nickel, and zinc price growth of between 2¾–8 percentage points. The impact on overall metal prices could last 4 quarters, with up to 5–6 quarters for lead and zinc, possibly due to weaker supply response. This is equivalent to a decline in price levels of around 1½–4½ below baseline levels, one year out (Table 4). The impact on crude oil prices is unclear—the impulse responses show a drop in crude price growth, with peak at around 3 quarters after impact, but are not statistically significant.







Conclusion

17. **Real estate investment accounts for a quarter of total fixed asset investment in China**. The impact on economic activity of a hypothetical collapse in real estate investment in China is sizable, with large spillovers to a number of China's trading partners. A 1-percent decline in China's real estate investment would shave about 0.1 percent off China's real GDP within the first year, with negative spillover impacts to China's G20 trading partners that would cause global output to decline by roughly 0.06 percent from baseline. Japan, Korea, and Germany would be among the hardest hit. In that event, commodity prices, especially metal prices, could fall by as much as 0.8–2.2 percent below baseline one year after the shock.

18. **Capital goods manufacturers that have sizable direct exposure to China and are highly integrated with the rest of the G20—Japan and Korea—would experience the largest declines in industrial production and GDP**. Worsened global growth prospects would be reflected in asset prices and sovereign bond spreads. In that event, commodity prices, especially construction-related metal prices, would also fall.

19. **The effects estimated here may understate the impacts**. The sample contains at least one full cycle of real estate investment and property market in China, and represents China's increasing integration with the world economy. Strictly from a statistical point of view, this relatively short sample will make statistical relationships harder to detect and will be an important constraint on the richness of the models. Nevertheless, as the results suggest, there is still sufficient statistical information in the sample that allows us to learn something useful about China's interaction with the world in the recent past. It is important to stress, however, that China is more important to the global economy today than our sample would suggest and a China investment bust is not likely to be a linear event as measured by the model. The impact on G20 trading partners and therefore global growth today should be larger than described above.

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Boivin, J. and M. Giannoni (2008). "Global Forces and Monetary Policy Effectiveness," NBER Working Paper 13736.

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Appendix: The China-G20 Macro Financial FAVAR

Why a FAVAR?

1. **The factor-augmented vector autoregressive (FAVAR) approach offers a simple** and agnostic tool to identify and measure the spillover effects of innovations in investment and real estate investment in China on various international macroeconomic, financial, trade, expectations and labor market variables. At the philosophical level, the approach works on a plausible assumption that policy makers and market participants face information constraints (similar to the econometrician) when they try to gauge economic conditions and developments, e.g. economic activity, price pressures, liquidity, and credit conditions, etc. They try to overcome these constrains by exploiting the information from a very large set of economic indicators.

2. **Technically, the approach offers a natural solution to the degrees-of-freedom problem** in standard VARs by effectively conditioning VAR analysis of shocks on a large number of time series while exploiting the statistical advantages of restricting the analysis to a small number of estimated factors, which usefully summarize those time series. As it requires only a plausible identification of the shocks and not a precise identification (restriction) of the remainder of the macroeconomic model, simplicity of the VAR's approach is retained.

3. **By conditioning the analysis on a rich information set, the approach addresses 3 well-known criticisms of the low-dimensional VARs**, structural VARs, and Bayesian VARs in several applications. First, it resolves the problem of mis-measurement of shocks or policy innovations—typically arising from the inability to control for information market participants or policy makers use—which leads to incorrect estimated responses of economic variables to those innovations.[1] Second, it does not require the analysis to rest only on specific observable measures to represent certain economic concepts. For example, the concept of "economic activity" cannot be perfectly captured by one indicator, such as real GDP or industrial production. Including multiple indicators, e.g. retail sales and employment, could represent the concept better. "Price pressures" may be better represented by various measures of prices—CPI, PPI, commodity (metal, non-metal, fuel, or non-fuel) prices. "Interest rates" and "liquidity and credit conditions" cannot easily be represented by one or two series, but are reflected in a wider range of economic indicators.[2]

4. **Finally, for the purposes of policy analysis and model validation**, the impulse responses can be observed for a large set of variables that policy makers and markets care about.

[1] The "price puzzle", which occurs in monetary VARs because the models do not capture the signals about future inflation central banks may have, is an oft-cited example, and is usually resolved in a clumsy, ad hoc manner in standard VARs.

[2] If a true system is a FAVAR, but is estimated as a standard VAR (with factors omitted), the estimated VAR coefficients and the impulse response coefficients will be biased.

The Model

5. **Briefly, the model is a stable FAVAR in growth (except for balances and interest rates)** with 5 common factors for each region (China and the rest of the G20 economies) and China's real estate investment. The model uses one lag. The Cholesky factor from the residual covariance matrix is used to orthogonalize the impulses, which imposes an ordering of the variables in the VAR and treats real estate investment as exogenous in the period of shock. Specifically, the VAR ordering restricts China's real estate investment to exogenously impact China's common factors which then spillover onto global factors in the immediate period (one month) after the shock in a recursive fashion. By construction, there is no need to identify the factors separately because each region-specific set of common factors (or principal components) is an independent linear combination that spans the respective data set. The results are therefore robust to re-ordering within factor groups.

6. **Formally, the FAVAR is described by a set of measurement equations (1),** relating to observed China data and those of the other G20 economies—the X's, which are listed in Appendix B—to their unobserved principal components[3] or factors, the C's; and a reduced-form state equation, which governs the dynamics of the factors (2), as follows:

$$\begin{aligned} X_t &= \Lambda C_t + e_t \\ X_t^* &= \Lambda^* C_t^* + e_t^*, \end{aligned} \tag{1}$$

$$\begin{bmatrix} C_t \\ C_t^* \end{bmatrix} = \begin{bmatrix} \Psi_{11}(L) & \Psi_{12}(L) \\ \Psi_{21}(L) & \Psi_{22}(L) \end{bmatrix} \begin{bmatrix} C_{t-1} \\ C_{t-1}^* \end{bmatrix} + \begin{bmatrix} u_t \\ u_t^* \end{bmatrix} \tag{2}$$

where * denotes the non-China factors; e's are mean-zero error terms, which are uncorrelated with the C's, but can be serially correlated and weakly correlated across indicators; and, finally, the u's are reduced-form mean-zero innovations that are cross-correlated. For China, C consists of unobserved common factors (F) to be estimated as well as observed fixed asset investment or real estate fixed asset investment (R), depending on the application. These C's should capture region-specific economic conditions or concepts that a few time series cannot represent adequately. The u's can be written and interpreted as the sum of global exogenous shocks, driven by some global shocks and region-specific disturbances (see Boivin and Giannoni, 2008).

7. **Equation (1) relates to the information time series X to the common "forces" C**, which contains unobservable factors in F and observable variables in R. It also captures the idea that both F

[3] The principal components of a set of variables are obtained by computing the eigenvalue decomposition of the observed variance matrix. The first principal component is the unit-length linear combination of the original variables with maximum variance. Subsequent principal components maximize variance among unit-length linear combinations that are orthogonal to the previous components.

and R can be correlated in general, representing common forces that drive the dynamics of the data, X, in each economic region.

8. **Equation (2) is a VAR in global factors, China factors, as well as China's real estate investment** (or total investment in a different application). It specifies how these common forces evolve over time, and is usually interpreted as an atheoretic forecasting model. The off-diagonal elements of the matrix allow the shocks to affect the common factors of the other region both contemporaneously and over time. In essence, these off-diagonal matrix polynomials capture spillover effects across regions, which can be "switched on" or "off". For instance, if the upper right element is set to zero, then the model is restricted to have no feedback to the rest of the world from China variables.

Estimation

9. **Data are initially transformed to induce stationarity, as described in Appendix B**. Then a two-step principal components approach is used to estimate the model (see Stock and Watson, 2002; and Bernanke, Boivin, and Eliasz, 2005). In the first step, the common space spanned by the factors of X over time, or the C(F,R), is estimated using the first principal components of X. Denote it by $\widehat{\mathrm{C}}(F,R)$. When the number of time series is large and the number of principal components used is at least as large as the true number of factors, the principal components consistently recover the space spanned by both F and R. Since $\widehat{\mathrm{C}}(F,R)$ corresponds to arbitrary linear combination of its arguments, obtaining $\hat{\mathrm{F}}$ requires determining the part of $\widehat{\mathrm{C}}(F,R)$ that is not spanned by R.

10. **The second step involves estimating the FAVAR, equation (2), by standard methods** with F replaced by $\hat{\mathrm{F}}$. In theory, when the number of time series is large (in this case, 390) relative to the number of periods (in this case, 128), the uncertainty in the factor estimates can be ignored.

11. **This procedure is computationally simple and imposes few distributional assumptions**. This methodology provides a non-parametric way of estimating C(F,R), i.e. it does not impose the structure of a parametric model with precise distributional assumptions in the measurement equations (1).

Identification

12. **Two distinct sets of restrictions are imposed on the system (1)–(2)**. The first is a minimum set of normalization restrictions on the measurement equations (1), which are needed in order to estimate the model. This is the standard normalization implicit in the principal components. The normalization is done so that solutions to the estimation problem in (1), i.e. the estimated factors F and factor loading ・, can be distinguished from any transformation that would also satisfy equation (1), conditional on observing X. Normalization does not affect the information content of the estimated factors. The second restrictions are imposed on the factors and their coefficients in the transition equation (2) to identify the shock.

13. **The framework then identifies unforecasted innovation in real estate investment and traces out the impact of various economic variables of interest**. This framework is more appropriate for our analytical purpose than for monetary policy analysis, as the unforecasted portion of policy interest rate innovations are not interesting in the real world where central banks follow well known monetary policy rules and communicate their actions actively to influence markets.

14. **The second set of restriction is the identification of the structural shocks in the transition equation (2)**. A recursive structure is assumed where all the factors entering (2) respond with a lag to change in the exogenous variable (real estate investment), ordered last. In this case, there is no need to identify the factors individually, but only the space spanned by the latent factors, F and C*. The Cholesky factor from the residual covariance matrix is used to orthogonalize the impulses, which imposes an ordering of the variables in the VAR and treats real estate investment as exogenous in the period of shock. The results are robust to re-ordering within factor groups.

15. **As a result, no further restrictions are required in (1) and the identification of the shock** can be achieved in (2) as if it were a standard VAR.

V. JAPAN

16. Outward Spillovers from a Sharp Rise of Government Bond Yields[1]

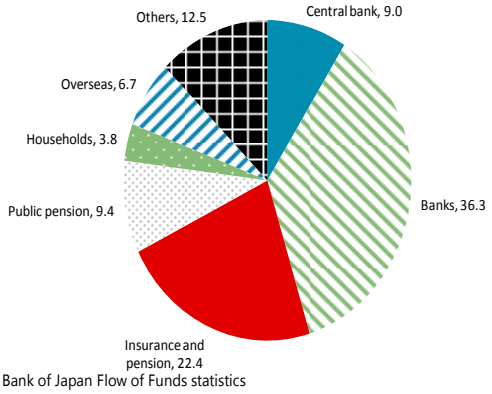
In the tail risk scenario of a sharp rise in Japanese government bond (JGB) yields by 200 basis points, outward spillovers to global output appear to be moderate unless the rise in government bond yields is accompanied by a sharp increase in global risk premia.

Background

1. **Previous studies have indicated that a sharp rise in government bond yields would be a key risk to fiscal sustainability and financial stability in Japan**. Both the Fall 2010 GFSR and the FSAP Update highlighted JGB market risks as a key vulnerability, although the financial system is expected to withstand a moderate shock to JGB yields. The 2011 Spillover Report found that the outward spillovers were moderate unless there was a sharp rise in long-term JGB yields (about 450 basis points) that led to capital losses and deleveraging abroad by Japanese banks. This note complements those analyses by quantifying the impact of a surge in government bond yields on global economic activity through contagion to global risk premia.

2. **JGB yields have remained low and stable despite high public debt levels but vulnerabilities remain**. The large holdings of outstanding JGBs in domestic banks raise concerns about financial stability (text chart). Close correlations of JGB yields with other key sovereign yields such as US Treasuries and German bonds might suggest that a sharp rise in JGB yields could have wider ramifications for global financial markets and the global growth outlook. In addition, the close trade ties of Japan with emerging Asia would imply that a growth slowdown in Japan could weaken the outlook in the region.

Japan - Shares of JGB Holdings at end-2011
(In percent)



Source: Bank of Japan Flow of Funds statistics

Model Framework

3. **The analysis uses the Global Integrated Monetary and Fiscal (GIMF) model to estimate the impact on global output.**[2] It is a multi-country dynamic structural general equilibrium model with optimizing behavior by firms and households, and full intertemporal stock-flow accounting. The

[1] Prepared by Ben Hunt, Keiko Honjo, and Stephan Snudden (RES), and Raphael Lam (APD).

[2] The simulation of the Global Integrated Monetary and Fiscal Model (GIMF) is based on a set of calibrated parameters and some underlying assumptions. Details are included in the IMF Working Paper No. 10/34 "The Global Integrated Monetary and Fiscal Model (GIMF)—Theoretical Structure" (Kumhof, Laxton, Muir, and Mursula 2010).

non-Ricardian features of the model, finite planning horizons, and liquidity-constrained households make it suitable to analyze fiscal policy questions. The model encompasses the global economy, explicitly modeling all bilateral trade flows and relative prices (including exchange rates) for 6 regions: the United States; the euro area; Japan; emerging Asia; Latin America and, as a single entity, the rest of the world. The international linkages allow an analysis of JGB market risks and potential policy spillovers at the regional and global levels.

4. **Three scenarios are considered for potential spillovers from a 200 basis points increase in the government bond risk premium.** The assumed increase is beyond the historical movement of JGB yields, which rarely increased by 100 basis points for an extended period over the last decade. Hence, the scenarios here should be considered as low-likelihood scenarios.[3]

- *Isolated increase in JGB yields*. This scenario assumes that the risk premium for JGBs increases by 200 basis points (phased in over 6 years to reflect the average maturity of the public debt) but the risk premia for other sovereign bonds are not affected. In response to higher yields, fiscal tightening via a tax increase is required to contain and eventually unwind the impact of higher debt-service costs on the public debt-to-GDP ratio. It is assumed that monetary policy rates in the euro area, the United States, and Japan are subject to a zero lower bound in the first two years. Afterwards, a monetary response is built in to be consistent with the underlying interest rate projections in World Economic Outlook (WEO) over the medium-term. Since Japan's short-term interest rate is projected to be at low levels over the medium term, it would remain more constrained on the monetary policy response than the United States and euro area in the model simulation.[4]

- *Moderate rise in global risk premia*. The increase of the JGB risk premium is the same as in the first scenario (200 basis points), but the risk premium in other regions would rise according to historical elasticities between JGB and other sovereign yields (see below).

- *Severe rise in global risk premia*. The increase in the JGB risk premium remains at 200 basis points, but spillovers to global risk premia are assumed to be more severe, based on estimates of elasticities between JGB yields and other sovereign yields at times of severe global shocks (see below).

5. **Contagion effects are calibrated.** Fluctuations in JGB yields correlate closely with sovereign yields of other advanced economies but less so with those of Emerging Asia and Latin America

[3] The increase in the risk premium assumed here is similar to that assumed in another background note, which analyzes global spillovers of a rise in the nominal interest rate in the United States (see "Effects of a Sovereign Debt Crisis in the United States").

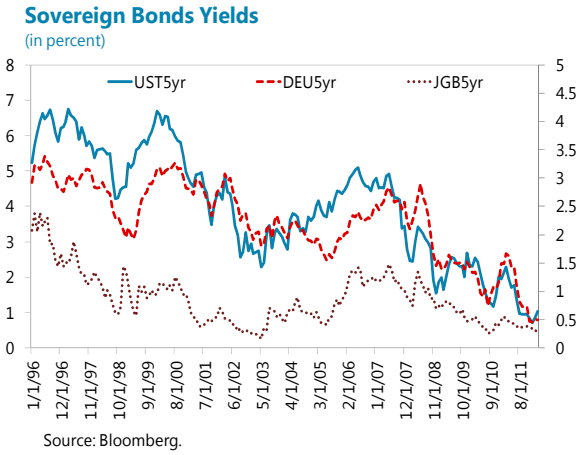
[4] Under the WEO baseline projection, short-term interest rates for the United States and euro-area are projected to stay around 60-80 basis points over the next two years (2012-13) and rise to about 2-4 percent over the medium term. Whereas in Japan, the short-term interest rate is projected to be about 30-40 basis points over the next two years and rise to about 75 basis points over the medium term.

(table 1 and text charts). Historical correlations of JGB yields with US Treasuries and German government bond yields are about 0.6–0.7 during 1996–2011, and increase to 0.8–0.9 at times of JGB shocks (defined as periods where a quarterly rise of JGB yields exceeded 50 basis points). The increase is particularly notable in Emerging Asia (excluding China) and Latin America at times of JGB shocks.

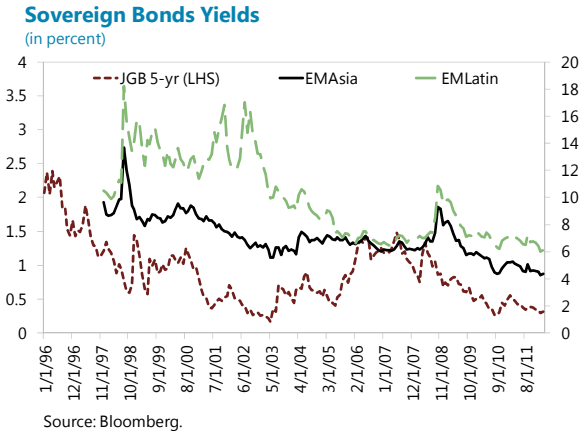
Table 1. Correlations of Global Sovereign Yields and JGB Yields

	United States		Germany		EM - Asia based on EMBI yields	China	Latin America
	5-year	10-year	5-year	10-year			
Baseline: full sample (1996 Jan to May 2012)							
JGB 5-year	0.71	0.70	0.63	0.67	0.40	0.08	-0.07
JGB 10-year	0.73	0.75	0.62	0.73	0.42	0.24	0.09
Lagged JGB 5-year	0.71	0.70	0.64	0.67	0.43	0.12	-0.06
Lagged JGB 10-year	0.73	0.75	0.63	0.73	0.45	0.28	0.11
JGB shock scenarios 1/							
JGB 5-year	0.90	0.90	0.84	0.81	0.97	-0.69	0.91
JGB 10-year	0.90	0.93	0.90	0.87	0.99	-0.75	0.93
Lagged JGB 5-year	0.89	0.91	0.80	0.78	0.62	0.95	0.84
Lagged JGB 10-year	0.85	0.90	0.84	0.83	0.48	0.96	0.74

1/ Historical JGB shocks consider the periods where quarterly JGB yields rose by more than 50 basis points in a quarter. JGB yields rose relatively sharply in 1998-99 and 2003.



Source: Bloomberg.



Source: Bloomberg.

6. **Global risk premia estimates**. Regressions of global sovereign yields on JGB yields accounting for autocorrelation, possible endogeneity, and other control variables suggest that a 1 percentage point rise of JGB yields typically would be associated with a rise of 5–10 basis points in US Treasuries and Euro-area bond yields (Table 2).[5] The estimates do not suggest a causality

[5] Other variables include measures of global market volatility (VIX index) and of the term premium (proxied by the slope of the yield curve) if the data sample allows.

relationship between JGB yields and other sovereign yields. The regression, nonetheless, attempts to isolate the rise of global risk premia from JGB yields increase by including lagged dependent variables, a proxy for term premium, and a proxy for common factors (measures of market volatility) that could drive the global risk premia.[6] The analysis suggests that at times of historical large rises in JGB yields (about 10 episodes), global sovereign yields would have increased by more, between 10 and 210 basis points given a 2 percentage points increase in JGB yields. In case of severe contagion, the associated rise in global risk premia has been much higher, ranging from 90 basis points for the United States and 280 basis points for Latin America, which could reflect the possibility that these regions faced a common shock.[7] The higher impact on Latin America could be driven by exposures of retail foreign exchange positions in investment trusts.

Table 2. Estimated Changes on Global Yields in case of a Sharp Rise in JGB Yields 1/

	Impact on global sovereign yields (in basis points) 4/			
	United States	Euro-area	Emerging Asia 5/	EM Latin America
Baseline- full sample period (1996-2011)	19	8	6	52
Parameters used in GIMF model simulations for a 200bp rise in Japan government bond yields				
Scenarios:				
(1) Isolated increase in JGB yields	0	0	0	0
(2) Moderate rise in global risk premia based on historical rise in JGB yields 2/	43	111	11	208
(3) Severe rise in global risk premia based on severe increase of global risk premia 3/	93	200	142	279

1/ The estimated impact of a 200 basis points increase in JGB yields on global sovereign yields

2/ Historical JGB shocks consider the periods where quarterly JGB yields rose by more than 50 basis points in a quarter.

3/ Include periods where there was a significant rise of global risk premia proxied by the VIX index beyond the two standard deviation level. The impact on the Euro-area in the severe case is taken as roughly double the historical shock.

4/ The estimation does not intend to illustrate a definitive causality relationship. Historically, rapid increases in the JGB risk premium (e.g., the VAR shock in 2003) were largely due to domestic shocks.

5/ Emerging Asia refers to the average impact of sovereign yields on China and other emerging countries in Asia.

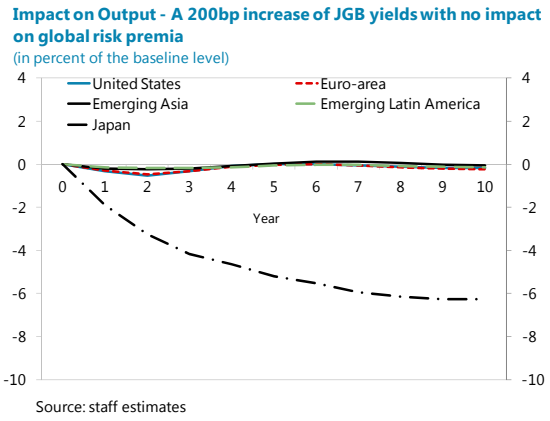
[6] Granger causality tests show that movements in global yields generally precede those of JGB yields while the reverse causality from JGB yields to global yields does not appear to be statistically significant (Lam and Tokuoka 2011).

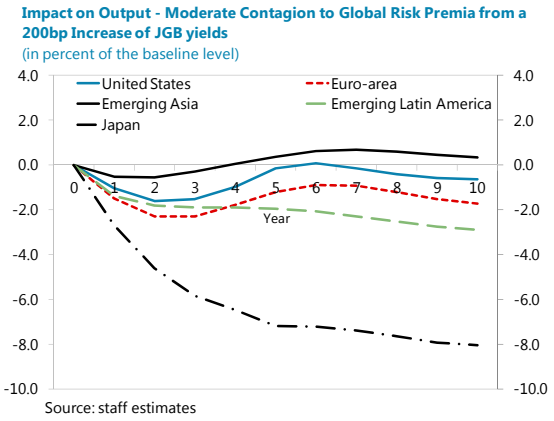
[7] As JGB yields have not risen by 200 basis points over the past decade, the impact on yields of other regions is extrapolated using coefficients from the linear regression. The true impact could be understated if the sharp rise in JGB yields triggered a large-scale sale of foreign sovereign bonds, or the impact could be overstated, if capital outflows from Japan generate safe-haven flows into other foreign government bonds.

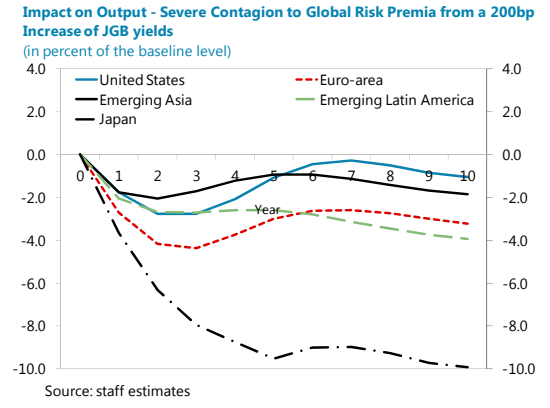
Results

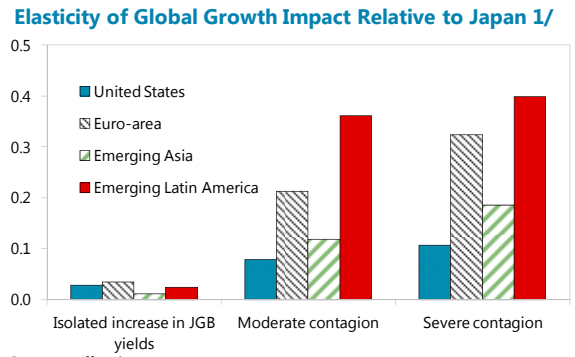
7. **The rise in the JGB risk premium would reduce Japan's output by about 6-10 percent after ten years, depending on the extent of contagion abroad** (Figure 1 and Table 3). Public debt-services costs would rise gradually (given the average maturity of JGBs is about 5-6 years), while private sector borrowing costs are assumed to jump immediately by the full magnitude. As a result, private consumption falls sharply, reaching a trough 6–9 percent below baseline after five years. The public debt ratio as a percent of GDP rises by nearly 10 percentage points in the first two years. Fiscal policy is assumed to respond to higher debt-service costs through a rise in the consumption tax rate. This would limit the increase in the public debt-to-GDP ratio, which peaks at about 15–30 percentage points higher than the baseline, and put the debt ratio on a downward path over the long term. In turn, the fiscal contraction weakens domestic demand. With weaker domestic demand, imports decline while the depreciated yen helps support external demand for Japanese exports, thereby mitigating the fall in output. Output declines by 5–9 percent relative to baseline after five years (or 6–10 percent after ten years).

Figure 1. Japan: Simulated Impact of JGB Market Risks on Global Output









Source: staff estimates.

1/ Cumulative decline of individual region's output relative to that of Japan's output after 10 years. For Emerging Asia in moderate contagion, the elasticity refers to trough output decline as output recovered afterwards.

8. **Similar to earlier studies, the outward spillovers from a sharp rise of JGB yields appear to be moderate unless contagion to global risk premia is severe**. Specifically,

- In the first scenario, the impact on GDP in other regions is very small (less than ¼ percentage point) as there are no spillovers into their risk premia over the 10-year horizon. For the United States and euro-area, the initial impact is about ½ percent on output as monetary policy cannot adjust because of the zero lower bound on policy rates.

- Assuming a moderate spillover to global risk premia (about 40 basis points to US Treasuries and 100 basis points for Euro-area bonds), it would reduce output in the United States by 0.6 percent and the Euro-area by about 2 percent relative to the baseline level after 10 years. The initial larger impact on the United States and euro-area is due to the inability of monetary policy to adjust under the zero lower bound on policy rates in the near term. Nonetheless, overall outward spillover appears moderate for advanced countries partly due to small foreign holdings of JGBs (near 7 percent of total JGB outstanding as of end-2011). The larger impact on Latin America reflects a larger rise of the risk premium (about 2 percentage points), partly attributable to exposures of Japanese retail foreign exchange positions through investment trusts.

- In the scenario of a severe rise of global risk premia, the spillovers to the global economy are more pronounced, ranging from a 1 percent decline in US output to a 3 percent decline in the Euro-area's output after 10 years. The decline in output in Emerging Asia would be moderate about 2 percent below baseline driven in part by limited sensitivity of the risk premium in China to a rise in JGB yields.

Table 3. Simulated Impact on Global Output based on GIMF Model

	Japan	United States	Euro Area	Emerging Asia 3/	Emerging Latin America	Rest of the world
Isolated rise of JGB risk premia	-6.3	-0.2	-0.2	-0.1	-0.2	-0.2
Moderate rise of global risk premia (based on historical JGB shocks 1/)	-8.1	-0.6	-1.7	-0.3	-2.9	-2.0
Severe rise of global risk premis (based on severe global shocks e.g., Lehman crisis 2/)	-9.9	-1.1	-3.2	-1.8	-4.0	-3.7

1/ Historical JGB shocks consider the periods where quarterly JGB yields rose by more than 50 basis points in a quarter.

2/ Includes periods where there was a significant rise of global risk premia proxied by the VIX index beyond the two standard deviation level.

3/ For Emerging Asia in moderate contagion, the elasticity refers to trough output decline as output recovered afterwards.

Source: Fund staff estimates.

9. **The results need to be interpreted with caution.** An important limitation of the model analysis is that it does not explicitly specify the financial sector. Separate network analysis, as applied

in the Financial Sector Assessment Program (FSAP) Update, illustrates that outward spillovers from Japanese banks to regional financial centers through credit and funding channels could be large if the system-wide distress on cross border claims of the Japanese banks was sizable. This reflects the increasing presence of Japanese banks in the region. Spillover risks to banks in the United Kingdom and the United States are also notable under such sizable shock due to large cross-border exposures. Nonetheless, the evidence of a statistical causality that a rise in the JGB risk premium would cause global risk premia to rise is not very strong. The regression has attempted to isolate the impact of JGB yields on global risk premia by introducing control variables, but there are possibilities that the model results may overstate the spillovers to global output.

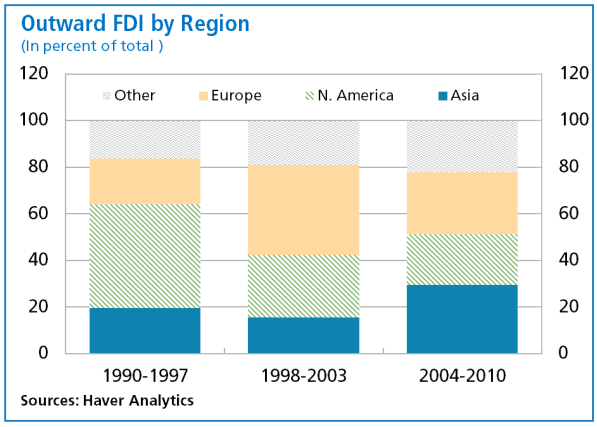
17. Spillovers through Japan's Overseas Direct Investment[1]

Japanese businesses have steadily expanded their overseas engagement during the last decade. Foreign direct investment and bank lending picked up since the early 2000s as corporate balance sheets improved and growth in Asia accelerated. The outward-orientation of businesses is likely to continue to grow steadily as the regional growth outlook remains robust, prospects for domestic investment are uncertain, and the yen is unlikely to revert to the low levels seen during the carry-trade period. An acceleration of Japan's outward FDI would be associated with higher growth in emerging Asia. But the effect would likely be moderate—a doubling of Japan's FDI to 1 percent of GDP in receiving countries is estimated to boost growth in emerging Asia by a ¼ percent.

Key Features of Japan's Outward FDI Flows

1. **Outward FDI has historically been low by international standards** (Figure 1): the stock of Japan's FDI as a percent of GDP is the lowest among the G7 countries, while outflows for the last five years have been less than half the G7 average. Key factors are (i) *legacy effects* from the corporate and financial sector crises following the bubble burst in the late 1980s; (ii) reverberations from the Asian crisis in the late 1990s; (iii) a decline in *unit labor costs* especially since 2007 as a result of *deflation* and later a *weak yen*; and (iv) the prevalence of *vertically integrated corporate groups* (*keiretsu*), whose business models are based on generating synergies from close relationships between a firm and its suppliers[2] (which has hindered cost reductions via offshoring).

2. **But Japan's FDI has increased steadily over the last decade,** increasing nine fold as a share of GDP since 1993 reaching to 3.3 percent of GDP in 2010, close to peak levels achieved prior to the global crisis.



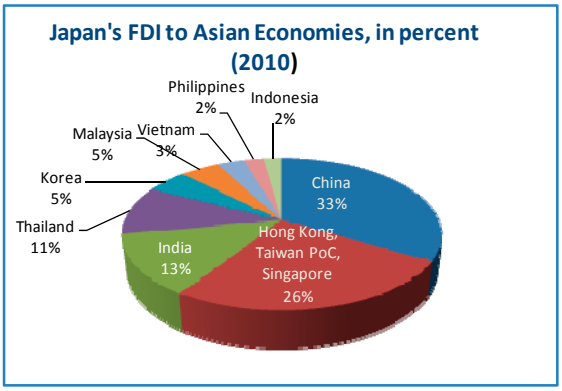
3. **Asia has been the main recipient of Japan's recent FDI flows**. Until the mid-2000s, North America and Europe were the main destinations of FDI, in particular, in the automobile and transportation sectors. With the rise of China and growing benefits from participating in regional production chains, Japanese businesses began to shift their investment to Asia, attracted by fast

[1] Prepared by Stephan Danninger (APD).

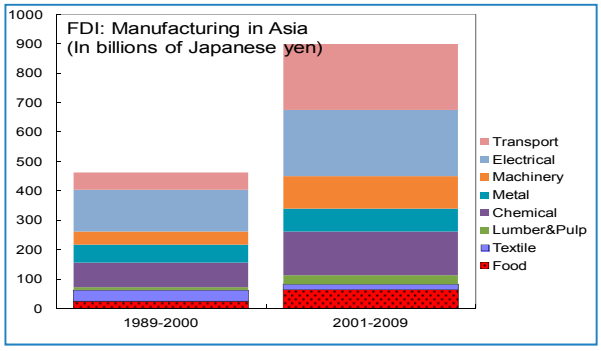
[2] Close ties between Japanese firms and domestic suppliers align incentives for innovation and productivity growth, thereby internalizing positive externalities (Contractor, et al. 2011). The benefits from greater domestic vertical integration may outweigh gains from offshoring costly production processes. The keiretsu system is also considered an obstacle to domestic market penetration via inward FDI, although empirical evidence is mixed (Weinstein, 2004).

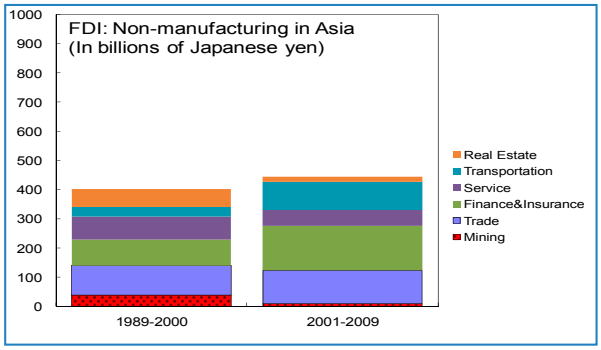
growing markets and costs advantages (JBIC 2011).

4. **Within Asia, more than 50 percent of Japan's investment goes to China and economies closely tied to it** (Hong Kong SAR, Taiwan Province of China, Korea, and Singapore). More recently, FDI has accelerated to countries with fast growing domestic markets and infrastructure needs (India and Indonesia) and low-cost producers (Thailand and Vietnam).



5. **Japan's FDI within Asia has been concentrated in the manufacturing sector**. More than half of Japan's FDI has gone to traditional industries, such as transportation, electrical and other machinery, and textiles. This pattern is Japan specific and the share of manufacturing FDI is substantially larger than that in other G7 countries (about 2.5 times). The main factors behind this trend are a catch-up process to other advanced economies in the aftermath of yen appreciation, rising growth opportunities in overseas markets, and diminished domestic growth expectations at home, especially since the global crisis. According to a JBIC survey, the share of manufacturing firms planning to expand operations in Japan has halved since 2007 and is mirrored by a parallel increase in intentions to enter new growth markets (JBIC 2011).

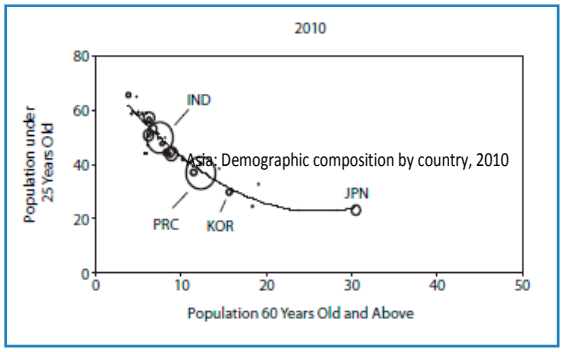




Will FDI Outflows Continue?

6. **The pull—and push—factors that led to the recent increase in FDI outflows will likely remain relevant for some time**, suggesting an acceleration of outward FDI over the coming period:

i. *Sound regional growth prospects*. The proximity to emerging Asia provides Japanese firms with profitable new investment opportunities. Asia's still sizeable labor reserve combined with the



Source: Lee, Mason, and Park 2011

emergence of large domestic markets (e.g., China, India, and Indonesia) and the existence of close regional production and trade linkages, will continue to support regional growth. IMF (2012) estimates that growth in Asia will stay near 8 percent over the medium term, which is significantly higher than in other emerging regions.

ii. *Weak domestic growth prospects and uncertain investment environment.* A slowdown of domestic demand limits investment opportunities and a decline in labor supply due to aging are limiting Japan's growth potential to an estimated 1 percent p.a. over the medium term. Looking ahead, this slowdown is exacerbated by a need to reduce the public debt-to-GDP ratio—requiring fiscal consolidation of 10 percent of GDP over the next decade. Uncertainty about Japan's energy situation following the 2011 earthquake and tsunami further reduces incentives for domestic investment.

Potential Growth in Japan

	2007	Medium-term
Potential GDP growth	1.4	1.0
Contributions from:		
Labor	0.1	-0.2
Capital	0.7	0.4
TFP 1/	0.7	0.8

Note: IMF staff estimates
1/ Total factor productivity.

iii. *Yen appreciation:* Volatility in global financial markets and safe haven effects have led to a strengthening of the yen, making overseas acquisitions and investment more attractive. Empirical analysis of Japan's FDI outflows confirms this link—periods of yen appreciation are followed by a rise in the share of overseas production by Japanese businesses (Figure 2).

iv. *Healthy corporate balance sheets.* Despite the deep recession in 2009 and an uneven recovery, balance sheets of large Japanese corporations have remained healthy due to intensive cost cutting during the crisis. Cash flow in large and medium-sized firms currently exceeds investment, while debt levels have remained stable or fallen except for smaller businesses. Since 2008 the nonfinancial corporate sector ran financial surpluses that exceeded 5 percent of GDP in 2010. As returns on these surpluses are very low, firms have an increasing incentive to locate profitable opportunities abroad.

7. **Over the near term, outward FDI may also accelerate in response to balance sheet deleveraging by European banks**, which deepens the pool of assets available for sale. Recent data by the BIS shows that lending by Japanese banks to Asian emerging economies increased throughout 2011, while exposures to Europe decreased at an accelerating pace.

Japan: cross-border consolidated bank claims

(in percent)	Q1-Q2 2011 qoq growth	Q3-Q4 2011 qoq growth
All countries	3.2	0.9
GIIPS	3.9	-12.6
Europe	2.5	-4.0
UK	2.1	3.9
US	2.4	3.6
Asia Pacific	6.1	3.0
Advanced	5.7	1.9
Emerging	6.5	4.3

Source: BIS

What are the Growth Spillovers from Japan's FDI Outflows?

8. **FDI is generally assumed to have a positive impact on growth in destination countries, but there are conflicting views**. On the upside, foreign investment is seen as enhancing capital formation and productivity through technology transfers and know-how spillovers, such as business management techniques (Romer 1990). On the downside, FDI may crowd out domestic investment or exacerbate misallocations of labor and capital, especially, if the economy suffers from trade, price, and financial distortions.

9. **Empirical studies generally confirm these different possible outcomes**. Herzer (2012) finds that across a large panel of developing and emerging economies, country-specific empirical relationships between FDI inflows and growth range from strongly negative to strongly positive. In line with the results of other studies, the paper finds that positive growth effects of FDI are associated with higher freedom from government intervention, less FDI volatility, primary export dependence, higher per-capita income, human capital, and legal institutions.

10. **Potential economic spillovers from an acceleration of outward FDI to emerging Asian economies are estimated using an augmented growth model**. In contrast to previous studies, the analysis covers a more recent time-horizon (1985–2010) and focuses on mainly emerging Asian economies (China, Hong Kong SAR, India, Indonesia, Malaysia, Philippines, Thailand, and Vietnam). As a result, per-capita income levels are higher and institutions more developed—especially after the Asian crisis—than in samples of other studies. This should increase the likelihood of detecting a positive association between FDI inflows and growth.

11. **The empirical model augments a standard growth model to include FDI flows**. Annual real GDP growth, Y_{it} is modeled as

$$Y_{it} = F(X_{it}\ \Delta FDI_{it})$$

where X_{it} are country-specific controls[3] and data on FDI inflows are measured in percent of recipient countries' GDP. The model distinguishes between overall FDI inflows, inflows from other advanced economies, and Japan-specific inflows, to assess whether growth effects in destination countries differ by the country of origin.

12. **The model is estimated using two approaches**. In its basic specification the growth model is estimated as an unbalanced panel with lagged changes in FDI given the potential for endogeneity between FDI and economic growth. A second set of specifications uses a dynamic panel estimation approach (Arellano Bond) and instruments on the change in FDI with its past values.

[3] The 1985 level of per capita GDP in US dollars, the degree of trade openness in percent of GDP, the change in the national investment rate, labor force growth, the change in the average years of schooling, private credit growth, and the inflation rate (all in destination country).

13. **The estimation results are summarized in Table 1**. The overall fit of the standard panel models is relatively good with an overall adjusted R^2 of over 0.6 (0.2 when excluding fixed effects). The key controls have the expected signs (e.g. initial per capita level, investment rate, education, and inflation) except for the rise in the labor force, which lowers growth once controlling for the level of education.

14. **FDI inflows are positively associated with economic growth**. All four specifications show that an acceleration of FDI leads to a rise in economic activity in the receiving economy. The estimated elasticities for overall FDI growth imply that a 1 percent of GDP increase in overall FDI (column 1) leads to an increase of growth by around 0.4 percentage points. This finding is robust to the exclusion of China, which has received little FDI but has grown very rapidly.

15. **The growth boost of FDI from Japan (columns 2 and 4) appears to be somewhat higher than that from other countries with coefficients ranging from 0.5–0.7**. A potential explanation for the larger growth effect of FDI from Japan may be a reported high local procurement ratio by foreign subsidiaries in emerging Asia.[4] Also greenfield investment by Japanese industries appear more prevalent and since the establishment of production facilities require upfront investment, growth effects could materialize fairly quickly in the receiving country.

16. **The findings point to moderate macroeconomic implications of FDI** via limited growth spillovers to the region. A doubling of Japan's outward FDI to emerging Asia from 0.5 percent of GDP to 1 percent of GDP in receiving countries would generate a one-time growth boost of 0.25 percent in emerging Asia (assuming an FDI growth coefficient of 0.5). Although this impact appears small relative to recent regional growth rates, its size is in line with Japan's relatively small overseas engagement in Asia compared to other countries and the limited reliance, especially in China, on FDI as a source of investment.

[4] According to the 2010 Survey of Overseas Business Activities by METI, local procurement of Japanese affiliates in Asia reached 73 percent in 2009 up from 58 percent a decade ago and exceeds procurement rates of affiliates in North America and Europe.

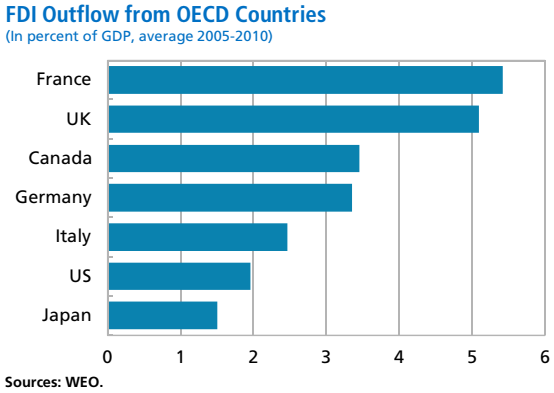
Table 1 FDI inflows and Growth in Asian Emerging Economies

	Real GDP Growth			
	(1)	(2)	(3)	(4)
Δ FDI in percent of GDP [1]	0.360*		0.490*	
	0.132		0.037	
Δ FDI other countries in percent of GDP [1]		0.346*		0.4784*
		0.136		0.036
Δ FDI Japan in percent of GDP [1]		0.584		0.685*
		0.548		0.254
GDP per cap 1985 ($US)	-0.013*	-0.013*		
	0.006	0.006		
Lagged GDP growth			0.363*	0.361*
			0.054	0.056
Openness (X+M)/Y	-0.001	-0.001	-0.001	-0.001
	0.006	0.006	0.005	0.005
Δ Investment wo FDI in percent of GDP	0.095	0.095	0.457*	0.458
	0.068	0.068	0.053	0.053
Labor Force (y/y)	-0.331	-0.331	0.118	.1179
	0.184	0.182	0.122	0.128
Δ Avg years of schooling	0.019*	0.019*	0.011*	0.011*
	0.007	0.007	0.004	0.004
Private credit (y/y)	-0.004	-0.005	-0.026	-0.027
	0.018	0.017	0.013	0.013
Inflation (y/y)	-0.184*	-0.184*	-0.117*	-0.117*
	0.040	0.040	0.030	0.030
Constant	0.123*	0.123*	0.055*	0.055*
	0.014	0.014	0.010	0.010
Estimation	OLS	OLS	Dyn panel	Dyn panel
Δ FDI instrumented (with lags)	N	N	Y	Y
Year FE	Y	Y	-	-
Country FE	Y	Y	-	-
Observations	204	204	195	195
R-squared (overall/ wo FE)	0.67/0.22	0.67/0.21	-	-

Notes: Fund staff estimates, standard errors below parameter estimates. Dependent variable: real GDP growth;[1] One-year lagged in OLS regression.[2] Barro-Lee 2011.

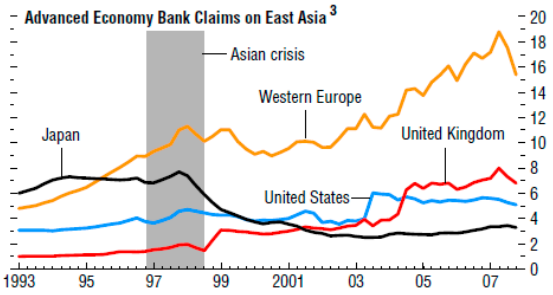
Figure 1. Japan's Role in Overseas Markets

Outward FDI is among the lowest in the G7



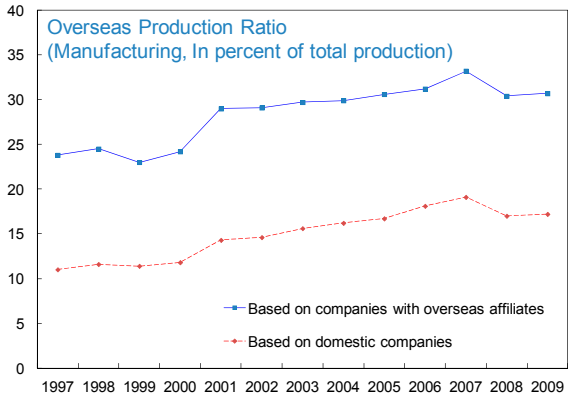
Sources: WEO.

...and overseas lending has been weak.

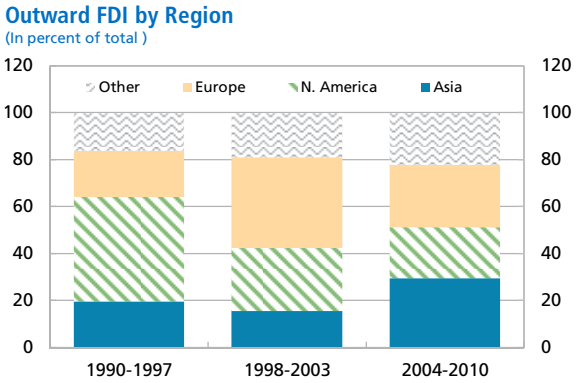


Sources: Bank for International Settlements (BIS); and IMF staff calculations.
[1]BIS-reported consolidated bank claims include claims of all branches and subsidiaries in foreign countries.
[2]Offshore Asia includes Hong Kong SAR and Singapore.
[3]East Asia includes Indonesia, Korea, Malaysia, Philippines, Taiwan POC, and Thailand.

Firms steadily increased overseas production

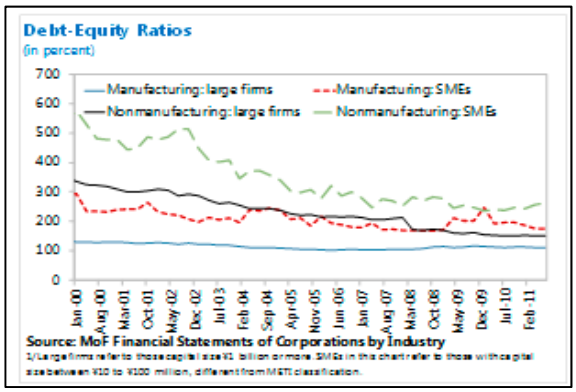


...with an increasing focus on Asia.



Source: Haver Analytics

Helped by stronger corporate balance sheets...



...and a strong yen.

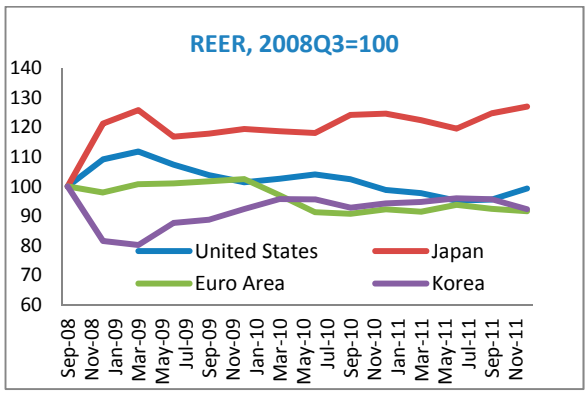
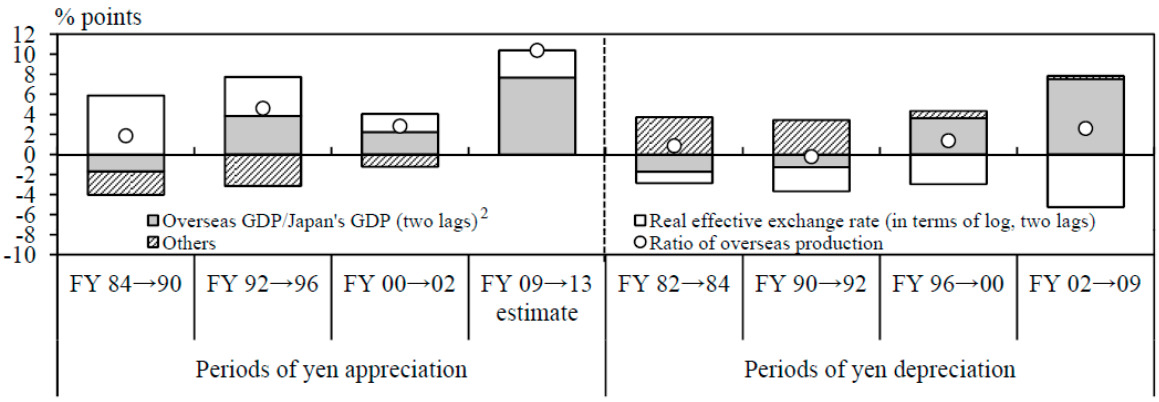


Figure 2. Overseas Production and Yen Appreciation

(3) Breakdown of Changes in Ratio of Overseas Production[4,5]



Ratio of overseas production = -86.7 + 3.2 × overseas GDP/Japan's GDP (two lags)
(-9.2) (16.9)
+13.3 × log of real effective exchange rate (two lags)
(6.9)

R^2=0.92, standard error of regression: 1.56

Source: Bank of Japan.

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VI. UNITED KINGDOM

18. The Role of the UK in Propagating Global Financial Shocks [1]

Network analysis and shock diffusion simulations are undertaken to analyze the role of the UK in the propagation of global financial shocks. The UK's ability to amplify or dampen a generic financial shock through the system is quantified. The analysis highlights the importance of global policies which protect the capacity of a "gatekeeper" such as the UK) to perform a "circuit-breaking" function in stemming such shocks.

Motivation, Analytical Approach and Relevance of the Results

1. **The structural features of global financial exposures can be captured as a network**. This network is composed of core and peripheral regions, and resembles rings of concentric circles. In theory, the presence of the UK along with other key global financial hubs at the core of the network implies that these countries (nodes) will play a different role relative to others in the process of spreading or mitigating the effects of a shock—the hypothesis worth examining is that differences between the countries at the core of the network will result in differences in shock spreading or mitigating efficiency.

2. **Network analysis permits the quantification of the relative contribution of a given country—in this case the UK—to amplifying or dampening a financial shock**. What is shocked is a bilateral link between two nodes—e.g., a claim or an obligation may be affected due to an event on either end of the link.

3. **The analysis supports the notion that safeguarding UK financial stability amounts to delivering a global public good**. Networked dynamic effects clearly identify the importance of the UK as a global market making and liquidity provisioning platform by G-SIFIs.

Data and Network System Construction

4. **BIS locational cross-border banking statistics (assets and liabilities) as of September 2011 are used as the starting point for constructing the network**, extracting bank to bank exposures between counterpart countries. BIS locational data set is used as it reflects more accurately the business model of the vast majority of cross-border banks, relative to consolidated level data which do not account for the significant locational operations and exposures in major financial centers. Nevertheless, while the locational data allow us to capture the unconsolidated balance sheets of subsidiaries and branches in multiple jurisdictions, it also aggregates these types

[1] Prepared by Karim Youssef (SPR).

of exposures with domestic banks' balance sheets. Thus, while the locational data provides for a better understanding of the G-SIFIs use of global financial centers, it also obfuscates the difference between the network effects arising from those exposures and the domestic banks.

5. **Exposures are represented in a directional networked system** (weighted by GDP of country exposed). The network arising from the BIS cross-border bank to bank exposures data indicates a fairly integrated and complex[2] structure representing exposures between 133 countries.

Methodology

6. **Our methodology consists of multiple steps aimed at generating an understanding of the structural features of this inherently complex network**. These features are subsequently used to facilitate a probabilistic mapping of the transmission channels for a shock through the network, including the identification of the dynamics and speed of the shock propagation as a function of the marginal contribution of particular types of nodes (such as hubs). In brief the methodology is to:

i) Determine an appropriate theoretically modeled network which—to the extent possible—both preserves the features and accounts for the complex characteristics of the BIS network.
ii) Assess the residual variations and associated complexities arising in the BIS network relative to the theoretically defined network, in order to explain these residual variations.
iii) Identify the countries which are most likely responsible for the deviations from the theoretical network.
iv) Quantify and test for robustness, the relative contributions of these countries to the residual complexity.
v) Use a shock diffusion simulation method to show how the residual complexity arising from the positioning and function of key countries (in this case the UK is the most important) causes a localized shock in the network to be amplified into a generalized shock rapidly spreading through the majority of the network.

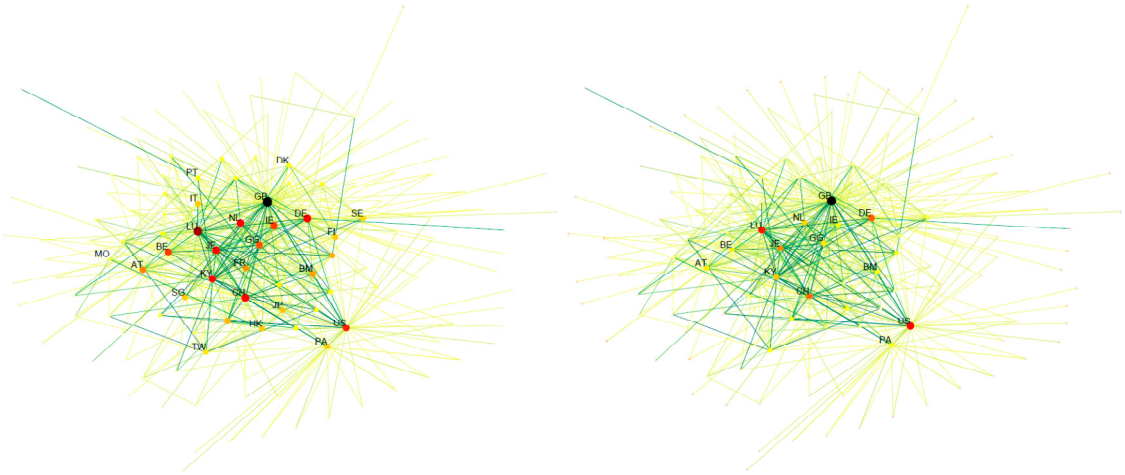
Results

7. **Relative to other financial hubs, the UK is identified as the foremost contributor to the residual complexity in the BIS network**. This is because UK is "central" not only in the sense that it has many connections (and connections to other well connected and important hubs), but also because it lies on the path between other pairs of nodes in the system, reflecting the UK's role as a financial platform for foreign banks that operate there.

[2] By complexity we mean that the network displays non-trivial features such as: i) non uniform density of the links across the regions of the network, which implies that some countries are more efficient at preserving or altering the stability of the network, and ii) a significant potential for feedback effects exits between a particular set of countries.

8. **The network arising from the BIS locational exposures is summarized in Figure 1**. The relative level of exposure between any two nodes is denoted by the thickness and color of the link between them (i.e. weight of the link in the network). The labels on the nodes indicate countries that have been identified as financial "hubs." The size and color of the node represents the identified relative efficiency of that particular hub in spreading a shock throughout the network. However, the identification of hubs without the use of our methodology—the left panel—does not capture the true extent to which some hubs are more efficient than others in shock propagation. The more appropriate identification of that variation between hubs is in the right panel, which in some cases even warrants the elimination of some hubs as they are not efficient spreaders of shocks.

Figure 1. Network of BIS Cross-Border Locational Banking Statistics at Q3 2011



9. **Three simulations were run to identify the impact of the most efficient hubs in shock propagation**. The three spreading process simulations use the network which best fits the summary statistics of the BIS network, as well as the BIS network itself. In each exercise: i) we simulate the shock spreading process 10,000 times; ii) the shock begins at one defined country and spreads to others via one/some of that country's outgoing links to others (based on a randomly selected weight threshold); iii) the progress of the shock transmission is described by the proportion of the countries affected by the shock via at least one incoming link at each point in time.[3]

10. **The specifications for shock origin and results of the three simulations are**:

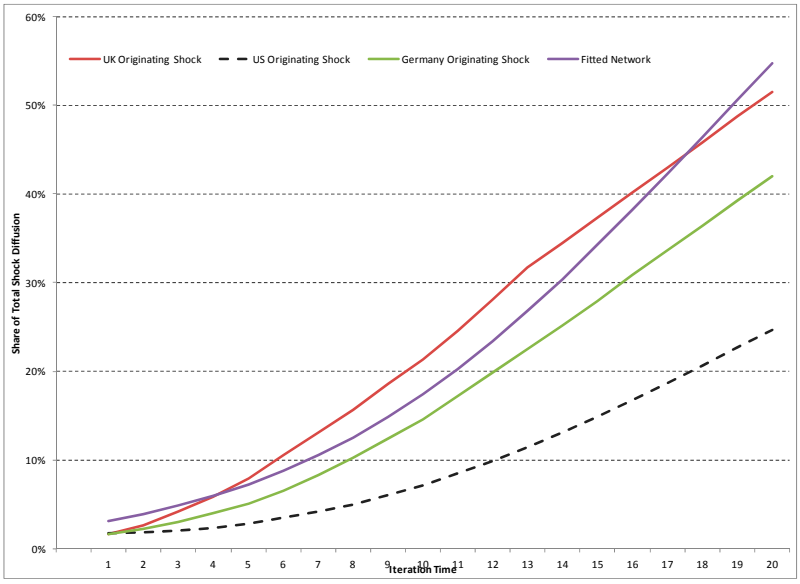
1) *Fitted Network with Random origin*: We use the network which matches to the extent possible the summary statistics of the BIS network; original shock is to links from a randomly selected node. After 20 steps, over half the network is infected. However, initially the rate of diffusion of the shock through the network is slower than other specifications (see 2 below).

[3] Note that the shock is to a bilateral link (e.g., Belgium having difficulty rolling over in Austria), not to the node (generalized Belgian funding problems). Thus, the exercise describes how a bilateral shock spreads through the network; it is not a generalized stress test.

2) *UK origin*: the shock is to one/some links emanating from the UK. After 20 steps, contagion reaches more than half the network. The result clearly indicates that the UK playing an initial shock propagation role produces a faster rate of diffusion relative to the fitted network.

3) *German and US origins:* these serve as additional comparators for the UK. In both cases, the UK's shock propagation capacity is greater. With respect to the US result, this reflects the reality that the majority of exposures to the US take place via balance sheets located inside the US, and conversely US banks are exposed to others via their operations abroad. Moreover, the residual cross-border links with the US arise with less extensive (i.e. less central) nodes such as Mexico and Canada. As such, the implication is that, unless a US based shock significantly affects US global investment banks, or precipitates a material price correction of globally held US dollar assets, it does not propagate very far.[4]

Figure 2. Financial Network Spillover Simulation



11. **Although the analysis does not model capital and liquidity buffers, it does suggest a role for such buffers**. Because so many foreign banks operate in the UK, a shock to their UK operations would spread further and faster than a similar shock occurring elsewhere. However, on account of data limitations, our framework does not delineate more clearly between the extent to which the UK based network impact refers to branches and subsidiaries of foreign owned banks versus domestic banks. Hence, the case for a more robust UK regulatory approach is strengthened, along with the need to increase collaboration and information sharing between the home supervisors and regulators of G-SIFIs operating out of the UK, and the UK authorities. Moreover, this may provide a case for a strengthened role for the UK authorities in supervision and regulation of domestically operating branches and subsidiaries of foreign banks.

[4] To test the significance of our prior that a US shock affecting links associated with global investment banks would produce a more efficient infection diffusion process, we ran the analysis with a higher probability that US links associated with other financial centers (i.e. internal balance sheets of global investment banks) are affected first. The results of this exercise were much closer to the efficiency of a UK originating shock.

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